WATER WORKS & SEWERAGE

L. H. ENSLOW, Editor

LEADING ARTICLES To Appear in the Next and Subsequent Issues:

"Water Supply Practice and Treatment for Railway Systems," by R. C. Bardwell, Engineer in Charge of Water Supply, Chesapeake & Ohio Railway System, will describe the various methods of securing water supply for railroads and the importance of water of proper quality for steam locomotives. In a second article Mr. Bardwell, who is an authority of railroad water practices, will discuss methods employed in treatment of railway supplies and its relationship to operating economy.

"Sewage Treatment at High Point, N. C." is the title of an article by E. H. Moss, Superintendent of Plants at High Point, and C. W. Mengel, Wm. C. Olsen, Engineers of Raleigh, N. C., who designed the two sewage treatment plants. The operating results and operating costs will be set forth for the sprinkling filters and separate digestion plant employing sludge beds for comparison with the same from the newer activated-sludge plant employing sludge dewatering on vacuum filters.

E. T. Cranch, Superintendent New Rochelle Water Company, New York, will continue with a series of articles on water works maintenance and operating problems. The next article will deal with maintenance and repairs of fire hydrants.

"Bleaching Clay in Water Purification" will be reported on by George D. Norcom, Sanitary Engineer of the Utility Service Staff Corporation, recounting experiences with absorbent clays in taste removal from an industrially polluted water supply.

"Experiences with Water Main Cleaning" are recounted in an article by Arthur T. Clark, Manager of the Greenwich Water Company, Greenwich, Conn.

P. S. Wilson, Consultant in Water Works Management, and formerly with the Community Water Service Corporation, will present an article dealing with the practical aspects to be considered in testing disc type water meters.

John R. Baylis will describe a new procedure and equipment for use in making odor and taste determinations which can be checked by individual observers.

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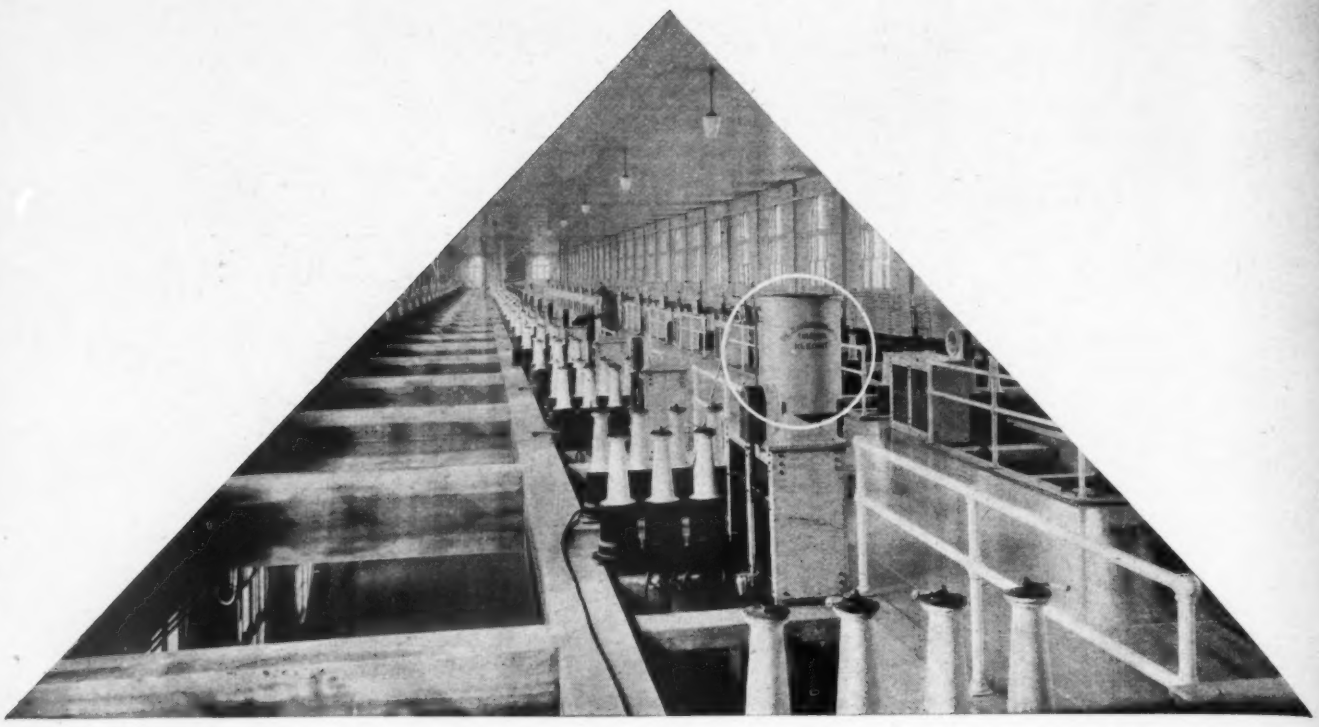

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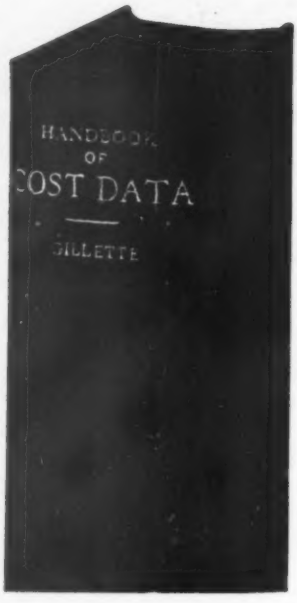

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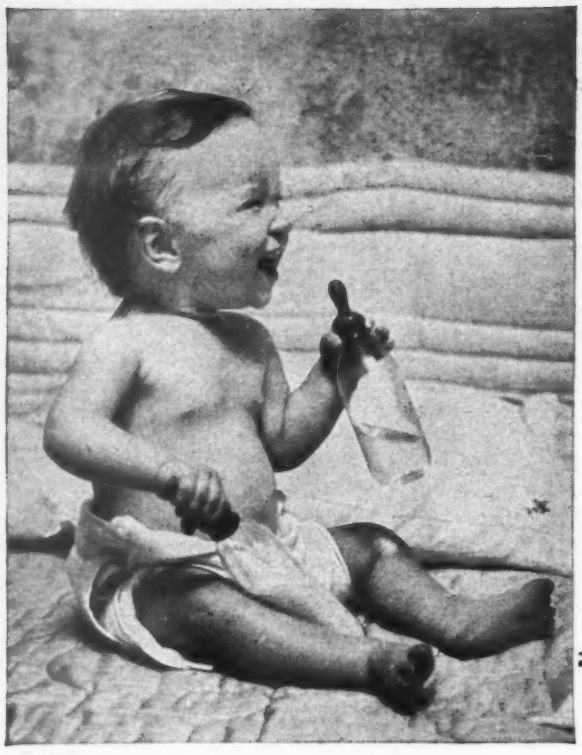

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WATER WORKS AND SEWERAGE

NOV. 1932

VOL. 79 No. 11

A GILLETTE PUBLICATION

CONTROL OF SEWAGE CONDITION BY CHLORINATION

By FRED D. BOWLUS[1] and A. PERRY BANTA[2]

INCREASED difficulties with the treatment of septic sewage at the disposal plant of the Los Angeles County Sanitation Districts led to an extensive survey to determine the quality of the sewage in the system and to arrive at methods and probable costs of correcting flow conditions and character of the sewage so as to deliver at the plant a product in a condition that would yield more readily to the activated sludge treatment process. Studies have been made of more than 10,000 separate analyses of sewage made during the past year at control points on the collecting system, and plans involving chlorination have been executed to correct the difficulty. A description of the survey methods, the corrective measures employed and the general benefits accruing are here given with the thought that our experiences may be of possible value to others confronted with similar difficulties or contemplating similar work.

The Sanitation District system (Fig. 1), including the joint disposal plant, of the activated sludge type, was placed in operation in February, 1928. Sanitary sewage and industrial waste from an area of 200 square miles drains through trunk sewers to the treatment plant which is located near the south boundary of the district. The area is quite flat, with resulting moderate velocities and long detention periods of the sewage in the lines. Sewage from all or part of fifteen incorporated cities, sixteen unincorporated communities and a large area of scattered suburban and industrial development enters the system. The center of population and industry is about fifteen miles north of the plant and therefore the bulk of sewage being treated has relatively the longest travel and detention period en route. These conditions are obviously favorable to maximum septicity and consequently are unfavorable to treatment by bio-oxidation processes. The trunk sewer from the plant to the most distant center of population is 20 miles long and the time required for that sewage to reach the plant is approximately fifteen hours.

Conditions in Southern California are especially conducive to anaerobic decomposition of sewage in sewers the year round. The combination of moderate temperatures of sewage and climatic conditions induces marked septicity within a few hours. These factors, together with the magnitude of the Districts' project, its thousand miles of sewers, flat grades, low velocities, and long periods of detention, form a combination which results in the delivery of septic sewage to the plant black in color with the solids finely comminuted. Another factor which contributes to the situation is the relation of line capacity to present flow. All lines were designed with velocities of at least 2 ft. per second at capacity but the present flow is considerably below the designed capacity of most of the lines.

The principal spur to the investigation looking toward the reduction of septicization of the sewerage in the collecting system was the total inadequacy of the activated sludge treatment plant under prevailing conditions to care for its designed capacity. During the cool winter months, with lowered temperatures and slightly larger flows, the plant functioned with fair efficiency, but in the summer months, with sewage temperatures averaging 79° F., the plant capacity was so reduced that some settled sewage had to be bypassed and the plant effluent was poor. Odor complaints were numerous. It was apparent that a means must be found to so control

[1]Resident Engineer; [2]Assistant Engineer, Los Angeles County Sanitation District, Los Angeles, Calif.

the character of raw sewage entering the plant as to permit of adequate treatment throughout the year of the volume for which the plant was designed. Furthermore, it was essential to derive data which would be of value in designing future plant extensions.

Industrial Wastes

At the outset of the survey it seemed apparent that packing house wastes were responsible for much of the trouble. The plants contributing such wastes are, with one minor exception, restricted by zoning laws to an area near the northerly boundary of the district and

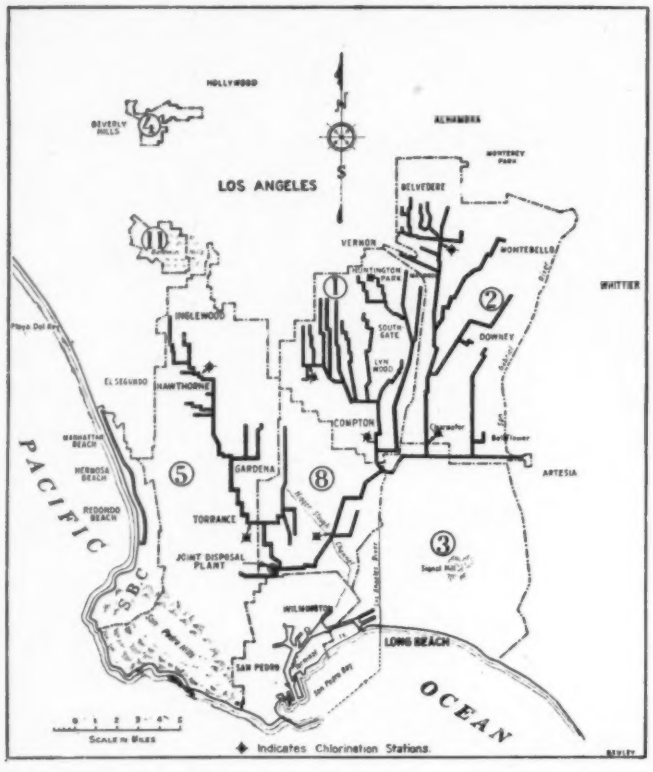


Fig. 1—Map of Trunk Sewer System of Los Angeles County Sanitation Districts, Showing Location of Chlorination Stations

while the combined daily discharge of such plants represents but 1 per cent of the entire flow through the system, its B.O.D. equivalent is nearly 8 per cent and its period of detention in the lines relatively the longest. Furthermore, the beginning of serious trouble at the sewage plant was concurrent with the admission of these wastes to the system two years after the plant was placed in operation. A brief summary of the extent and character of the packing house wastes is given below:

AVERAGE MONTHLY KILL

Cattle	Hogs	Sheep	Calves
6,000	13,000	14,000	6,000

Analysis of the combined wastes from these plants during a 10-hour working day, based on hourly samples, is as follows:

TABLE I

Flow	.142	m.g.d.
Total Solids	6,300	p.p.m.
Suspended Solids	1,306	"
Dissolved Solids	4,994	"
Chlorides	881	"
B. O. D.	2,100	"
Ammonia N	111.	"
Organic N	401.	"
Grease (approx.)	400	"
Average—Maximum Chlorine Demand	300	"
Average Chlorine Demand	116	"

Hydrogen sulphide was not detected in the local trunk serving the packing house area, but was excessive in a main some miles below and into which the packing house sewer discharges. This was particularly significant because by comparison no such decomposition had occurred in parallel trunk lines into which no packing house waste had been discharged. It may be stated here that throughout the investigation the amount of hydrogen sulphide present has been taken as the index of the degree of septicity. Starting with somewhat superficial observations covering the effects produced by the packing house wastes, an immediate study of this situation was undertaken. Experience gained and methods developed during the investigation of effects produced by this waste proved of considerable value when the work was expanded to include the entire system.

Some three hundred other industrial plants are known to be connected to the Sanitation Districts' sewer system, the largest contributing about one-half million gallons per day. During the two years prior to the detailed sewage survey, data had been collected regarding the nature of the factory wastes through conferences with officials and general inspection of plans. The information obtained in this manner was in many instances found to be misleading and inaccurate. As the sewage survey progressed it became apparent that actual measurement and analysis of these industrial wastes was necessary to secure reliable data. Often the very small establishments, employing but few men, produced the most objectionable wastes. Therefore the detailed survey was extended to include to specific investigations of wastes contributed by many of the industries and its effect, if any, upon the character of the sewage near the source and later in the lines below.

FIELD TESTS, EQUIPMENT AND METHODS

The pH value and temperature of sewage appear to be good indices of the presence of industrial wastes and have proven useful many times in locating the source of such contributions. These in conjunction with tests for hydrogen sulphide and quantity of flow at given locations, could be expected to indicate control points where rectification of sewage conditions would prove

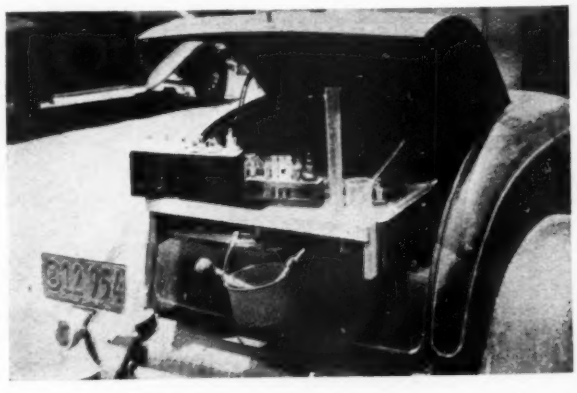


Fig. 2—Mobile Field Laboratory Used in Sewage Survey

most economical, and likewise indicate where individual waste contributions might be excluded or corrected with benefit.

After the survey had progressed a few weeks in the vicinity of the packing houses, a test for chlorine demand of the sewage was included. The five tests—temperature, pH value, hydrogen sulphide, chlorine demand and volume of flow, then constituted the field

analyses. In addition special and detailed analyses of particular wastes were made at the sewage treatment plant laboratory.

Mobile Field Laboratory

The complete field laboratory, including all equipment necessary to conduct the above field tests, was installed in the rear compartment of a Ford coupe (Fig. 2). The laboratory table was mounted on a sliding frame so that it could be pulled out over the rear bumper. While traveling between sampling points, the table was pushed back and the compartment closed. Each piece of apparatus was fitted into a tight recess in the table to minimize breakage. An electric light, attached to the underside of the rear compartment cover, illuminated the table at night. The equipment going to make up the field laboratory consisted of the following:

1—250 cc. graduate.
1—100 cc. graduate.
1—1,000 cc. beaker.
2—250 cc. beaker.
2—150 cc. beaker.
1—pH set 8.0 to 9.6.
1—pH set 6.8 to 8.4.
1—pH set 5.2 to 6.8.
1—Hydrogen Sulphide Comparator Set.
1—250 cc. bottle Orthotolidin.
1—250 cc. bottle 1/10 N. Potassium Iodide.
1—250 cc. bottle Sodium Thiosulphate.
1—250 cc. bottle Dilute Hydrochloric Acid.
1—qt. bottle chlorine water (Standardized).
1—qt. bottle distilled water.
1—25 cc. burette.
1—Thermometer.
1—Glass stirring rod.
1—3-qt. pail with rope.
1—2 cc. pipette with bulb.
2—60 cc. glass stoppered bottles.
1—Hydrometer bulb and glass.

It was necessary that determination of temperature, pH value hydrogen sulphide and chlorine demand determinations be made promptly and two men were able to secure a sample, make the four tests and be ready to move on to another station in about three minutes. Eight to ten locations were usually included in a circuit of stations and hourly samples could be secured from each throughout the working period, about half of the hour being consumed in travel between points.

For the quantitative test for hydrogen sulphide, the Salle-Reinke Antimony method[1] was used. A color comparator set, with standards ranging from 1 to 12 p.p.m. employing 4-ounce oil sample bottles as ampules, was constructed with spaces provided for blanks and standards as in the LaMotte pH set. The Salle-Reinke method with the comparator was checked repeatedly in the laboratory against the iodine method and against the total sulphur determinations and was found to be entirely satisfactory. This compact set permitted the tests to be made rapidly and accurately; particularly was this the case during night work when comparisons were frequently difficilt in the artificial light.

The chlorine demand test used was a modification of a procedure recommended by L. H. Enslow. The following simplified procedure was developed: To a measured sample of sewage exactly 2 cc. of chlorine water of known strength is added, followed by ½ cc. or more of orthotolidin reagent. If the mixture fails to produce a distinct yellow color the sample is discarded and a smaller portion used. When, upon addition of the orthotolidin, the color is definitely perceptible, more sewage is added gradually, but quickly, until the yellow color is dissipated, indicating a balance between the chlorine supply and demand. The calculation of the chlorine demand in p.p.m. is:

$$\text{Demand in p.p.m.} = \frac{\text{2x strength of chlorine water in p.p.m.}}{\text{Total cc. sewage in final sample}}$$

The principle involved in the procedure is that the amount of chlorine is always fixed while the variable is the amount of sewage to which it is added. If no yellow shows upon addition of the orthotolidin to the sample, it is evident that the chlorine demand of the sewage sample is greater than the supply added in the 2 cc. of chlorine water. The selection of the quantity of sewage with which to start the test is determined by a knowledge of its probable chlorine demand or by "cut and try" procedure. A few trials at any station will serve to indicate the volume required.

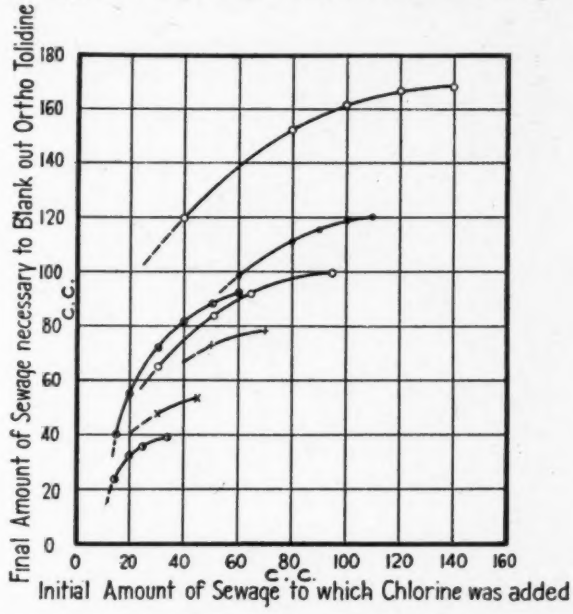


Fig. 3—Chlorine Demand Data: Graph to Illustrate Ratio Between Initial and Final Quantity of Sewage Used in the Test

Fig. 3 contains plotted results from some field and laboratory determinations of chlorine demands of various sewages. It will be noted that the slopes of curves become flat beyond the .80 point. If the ratio between the initial measured sample and the final measured sample is .80 or greater, the determination is considered accurate within a few percent. If the ratio is less than .80 the results are high and the procedure is repeated, using a larger initial sample of sewage, until the correct ratio is obtained. Results obtained in the foregoing manner were repeatedly checked in the laboratory against the longer procedure recommended by Enslow and showed accurate agreement. The method has also been checked against large scale chlorination of a measured flow of sewage and was found to check closely.

Survey Procedure

Work on the sewage survey commenced in September, 1931, and has continued to date without interruption. Sampling and testing have been generally confined to the four days of average flow in each week, Tuesday to Friday inclusive, with sufficient tests made on other days to insure complete data. Twenty-four hour tests at any control point were seldom made in one continuous run, but were composed of hourly observations over a period of two or three days. A number of 3-day continuous tests making hourly determina-

[1]Salle, A. J., and Reinke, E. A., 1929 Antimony Method of Sulphide Determination.—C. S. W. A. Journal. Vol. II, No. 1, pp. 208-209.

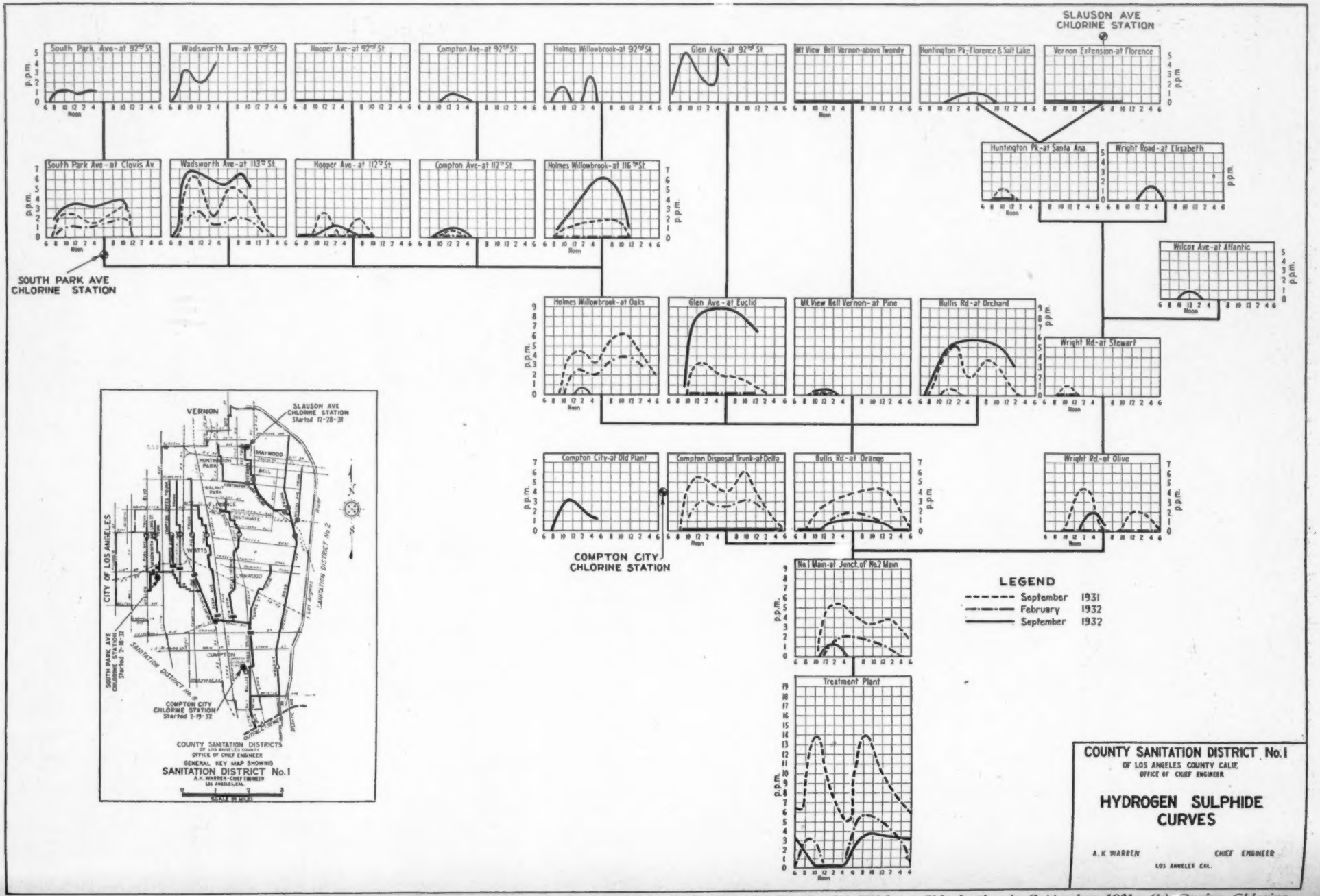


Fig. 4—Hydrogen Sulphide Data Taken at Several Points on Sewers in Los Angeles County Sanitation District No. 1. (a) Without Chlorination in September, 1931; (b) During Chlorination at Indicated Points During 1932.

tions were conducted at the treatment plant. Many additional tests were made at points not in the regular sampling circuits for the purpose of correlating and interpreting data obtained from the regular stations. After about four months' work it was possible to predetermine with fair accuracy what might be expected in the lines at any location at any time of the day or night, and consequently the work thereafter could be materially reduced.

Flow measurements in the districts' lines have been made four times annually since February, 1929, in order to determine ground water infiltration, per capita discharges and the influence of industrial wastes. In September, 1931, the flow data already accumulated was augmented with additional measurements of the many small trunks tributary to the districts' mains. Such measurements were made over weirs left in place for seven day intervals. Volumes were indicated by a continuous stage recorder.

Field notes were transferred to office records weekly. Curves, to picture findings, were constructed as soon as sufficient data was available. A typical example of the office record of field data is shown in Fig. 4, which discloses hydrogen sulphide concentration at the control points in District No. 1 and at the disposal plant during three complete surveys. Similar records of temperature, pH value, chlorine demand and flow were kept up to date as the survey progressed.

CHLORINATION PROGRAM

On Dec. 28, 1931, a 360-lb. chlorinator which was on hand was placed on the local sewer draining the packing house area. Although of insufficient capacity for high flows it served to demonstrate the effect of complete chlorination during periods of low flow and as a consequence a 720-lb. machine was substituted on Jan. 23, 1932. In addition two 200-lb. panel type machines and one 200-lb. vacuum type machine were installed elsewhere on the system. Subsequently, two 720-lb. and four 360-lb. Wallace-Tiernan chlorinators were purchased and placed in operation, replacing the two panel type and the 200-lb. vacuum type machines and supplementing the 720-lb. and 360-lb. machines already in operation. This provided eight chlorinators with a combined chlorine feed capacity of two tons per 24 hours which were located at predetermined points shown in Fig. 1.

The machines are housed in portable buildings of standard design, 8 by 14 ft. in plan, and constructed of corrugated galvanized iron. (See Fig. 6.) The wooden frame work is bolted together in sections. Each station is located close to a manhole, through which the chlorine solution feed line enters the sewer. Chlorine water is diffused into the sewage by means of a number of devices; the most satisfactory scheme at this time involves the use of perforated "Transite" pipe attached to the end of the chlorine solution hose and submerged in the sewage. Chlorine is purchased in 1-ton containers which are transported to the chlorination stations by truck and rolled into place through outward swinging doors hinged at the top onto a platform of the same height as that of the truck body. Similarly, empty tanks are rolled onto the truck for return shipment. No scales are provided to weigh the chlorine. In order to minimize the use of solution feed water, trial adjustments of each chlorinator were necessary on account of the variable suction head, size, and length of discharge hose. This involved changing injectors and tail pieces and manipulation of the pressure of feed water at each station until the most economical combination was found.

Theoretically, the chlorine feed should vary with the flow and strength of sewage, but an economical balance has been worked out between the expense of maintaining a full time operator at each plant and maintaining a constant feed rate with no attendant. Five of the stations are regulated three times daily, one is regulated twice daily, and two run continuously at a fixed rate. At two stations the chlorine is shut off daily for a period of several hours. One full time attendant and one part time night attendant handle the entire operation. An operating schedule, revised from time to time, is prepared for each station and is based upon the chlorine demand curve and hydrograph indicating changes in volume of flow past the station. The amount of chlorine required at any time of day can be determined from a nomograph for converting flow and chlorine demand to

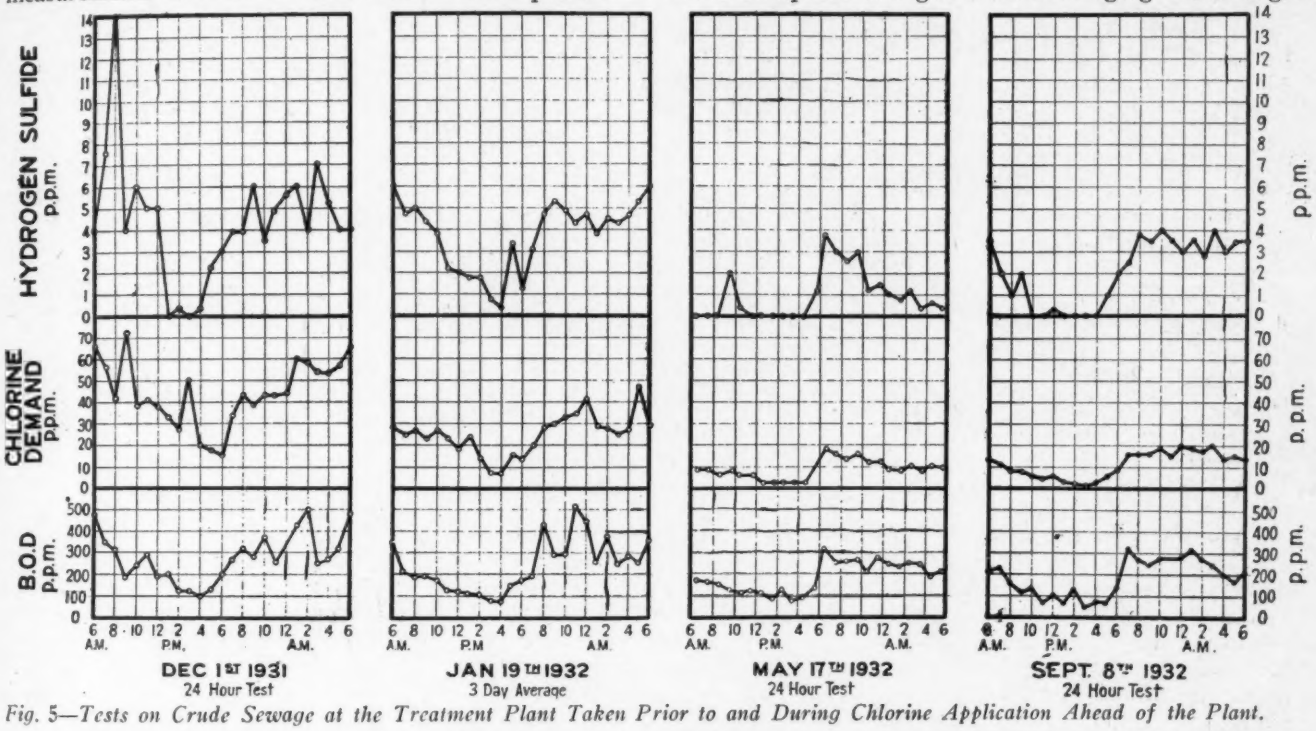


Fig. 5—Tests on Crude Sewage at the Treatment Plant Taken Prior to and During Chlorine Application Ahead of the Plant.

Fig. 4—Hydrogen Sulphide Data Taken at Several Points on Sewers in Los Angeles County Sanitation District No. 1. (a) Without Chlorination in September, 1931; (b) During Chlorination at Indicated Points During 1932.

dosage required. Complete reports are kept at each station of air temperature, chlorine feed, chlorine tank pressure and volume of water used. A weekly inspection of all stations is made by the engineer in charge of sewer operation and maintenance. The chlorine dosage is regulated at each station to achieve certain objectives. At five stations dosage is sufficient to just satisfy the chlorine demand of the sewage; at two stations a residual is maintained for a mile to two down sewers for the purpose of disinfecting sewage from unchlorinated incoming lines, whereas at the station near the treatment plant only partial chlorination appears to be required.

Effect of Chlorination in One of Three Similar Districts

The effect of chlorination on the District No. 1 sewage is shown in Fig. 4. This chart is taken as typical of similar work done in Districts Nos. 2 and 5. September, 1931, curves represent conditions prior to chlorination, while those for February, 1932, show the effect on the Wright Road Trunk of chlorinating packing house wastes only. The September, 1932, curves represent the conditions about as they have prevailed throughout the summer of 1932 subsequent to the installation of the South Park Avenue and Compton City chlorination stations in addition to the packing house chlorinator. The South Park Avenue sewer carries about one-fourth of the flow passing the Holmes-Willowbrook trunk at Oaks station. By dosing sufficient chlorination at the South Park Avenue station a residual is always maintained below the junctions of the Wadsworth Avenue and Hooper Avenue trunks. The hydrogen sulphide is reduced to a maximum of 1 p.p.m. in the Holmes-Willowbrook trunk at Oaks and in the Bullis Road trunk at Orange, a chlorine residual being present at both stations during the low night flow.

Generally speaking where partial chlorination has been practiced, the chlorine when diffused efficiently has quite consistently shown a tendency to combine with the dissolved hydrogen sulphide before satisfying the other chlorine demanding elements of the sewage. This effect has been noted many times when only sufficient chlorine has been added to satisfy the demand equivalent of the hydrogen sulphide.

A careful study of the sewage survey data and the economics of the problem led to the selection of the three stations which now quite completely chlorinate the sewage of District No. 1. Throughout the summer season a daily average chlorine feed of 700 pounds from these three stations has insured delivery to the Joint Outfall Sewer of eight million gallons of sewage, having a maximum of 1 p.p.m. of hydrogen sulphide.

Discussion and Comments

The effect of the partial preliminary chlorination of the packing house wastes started in December, 1931, on the total flow of sewage reaching the disposal plant was prompt and conclusive, as is indicated by the tests at the plant in December and January, shown in Fig. 5. A number of hydrogen sulphide determinations taken early in January indicated that former high peaks were reduced approximately to an average. The character of the incoming sewage was immediately bettered and was reflected in the improved efficiency of the treatment process.

After starting chlorination of the major part of the sewage for the first time in two years hydrogen sulphide was consistently absent from sewage entering the disposal plant for at least part of each day. The B. O. D. and chlorine demand of sewage reaching the plant were materially reduced. On Feb. 27 all of the flow reaching the disposal plant was completely treated for the first time since the packing house wastes were admitted into the lines. Plant conditions and effluent showed marked improvement.

With the chlorination program in full operation since May 1, 1932, hydrogen sulphide has been reduced to 1 p.p.m. at the plant during most of the day and peaks seldom exceed 3 to 4 p.p.m. The B. O. D. reduction in the incoming raw sewage amount to about 25 per cent. Solids are no longer finely comminuted and decomposed but are carried to the plant in a reasonably fresh divided condition. Odors are absent or are so reduced as to be indistinguishable a short distance from the plant. Odor

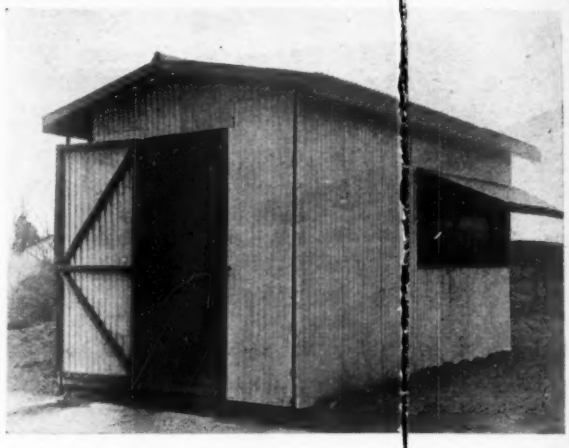


Fig. 6—Portable Chlorination Station Used to Study Chlorination Effects at Various Points on the Los Angeles County Sewers

complaints have practically ceased. The plant effluent shows a 70 per cent increased B. O. D. reduction over former conditions. Prior to January, 1932, hydrogen sulphide was often detected through the aerating tanks to the final clarifiers but has been entirely absent since that date. A year ago gas conditions in some of the main trunks made it dangerous at many points for the maintenance crew to enter without gas masks. This condition has been corrected and the sewer may now be entered at any point with safety.

Costs

During the summer of 1932 the daily use of chlorine by the three major Los Angeles County Sanitation Districts has averaged about 1 ton per day. Including all charges, except chlorination, sewage treatment at the Joint Disposal Plant costs $23.00 per million gallons. Chlorination adds $6.00, but inasmuch as the plant capacity has been trebled by the chlorination of sewage, it is apparent that an impressive saving accrues by making the plant effective for three times the sewage flow at an increased operating cost of but $6.00 per million gallons.

It is not concluded that chlorination as now practiced produces the maximum possible efficiency. The use of alkaline-hypochlorite is now being investigated with indications that an economy may be effected by such procedure.

The foregoing description of survey methods, appliances and the comments and conclusions must be considered in the light of a progress narrative. Work on the investigation will continue with, it is hoped, increased benefits and efficiencies. A. K. Warren is Chief Engineer and General Manager of the Los Angeles County Sanitation Districts. The sewage survey and chlorination program were carried out under the direction of A. M. Rawn, Assistant Chief Engineer.

CONVENTION OF NEW ENGLAND WATER WORKS ASSOCIATION

(CONCLUDED)

THE 51st Annual Convention of the New England Water Works Association was held in Springfield, Mass., on Sept. 27 to 30. Upon invitation the New York Section of the American Water Works Association met jointly with the New England Association.

The October issue of WATER WORKS AND SEWERAGE carried a report of the meeting, a summary of papers read and remarks made by discussors in the technical sessions during the first and second day of the convention. Here follows a summary of papers and discussions dealing with "Water Treatment and Quality."

Symposium on Water Treatment

R. H. Ellis, President-elect of the Association, presided over the sessions devoted to measures employed in treating water to prevent or eliminate tastes and odors.

"Powdered Activated Carbon in Water Purification," F. E. Stuart, Industrial Chemical Sales Co., New York, N. Y.

The remarkable growth of the use of powdered activated carbon in water treatment for taste and odor elimination was reviewed by Mr. Stuart, who reported its successful use at more than 400 filtration plants. As to the several benefits derived, that of adsorbing taste producing products and their removal along with the carbon by the filters or the settling basins, he said, remained the most important. Among other advantages noted, when the carbon had been added to the raw water, had been improved coagulation with reduction of coagulant dosage; improved clarification with attendant larger filter runs; a reduction in organic content of the water and consequent reduced chlorine requirement; a smoothing out of fluctuations in chlorine demand of the filtered water; and perhaps the most important asset had been the stabilization of sludge deposited in the settling basins. This had resulted in retarding putrefaction of the organic content of sludges. That effect had proved of economic advantage, in that frequency of basin cleanings could be reduced without the attendant danger of sludge rotting and thereby contributing foul tasting compounds to the new water passing through the basins to the filters. Such benefits had been observed at a number of plants—both at filtration and water softening plants.

A Group at the Springfield Filtration Plant.

Mr. Stuart pointed out that carbon dosages would have to be varied to meet local conditions, but usually between 8 and 24 lbs. per million gallons was sufficient. On account of the several advantages Mr. Stuart stressed the value of applying the carbon to the raw water, but in cases where sufficient carbon did not remain in suspension and reach the filters, a small quantity in addition might with advantage be applied just ahead of the filters. It appeared essential to have some carbon actually being deposited on the sand for best overall effects. In conjunction with prechlorination powdered carbon should be added preferably *ahead* of the chlorine and it had been found that the combination of carbon and prechlorination was particularly effective. Strangely enough, a higher residual chlorine value could be maintained through the basins, apparently as the result of the prior carbon addition. The residual, however, would always be removed completely during passage through the filters.

At the West Parrish Filtration Plant, Springfield Water Works. The Big "Seegar" Belongs to E. T. Killan of Alexander Potter's Office. Stephen H. Taylor, Superintendent Water Works at New Bedford, Mass., Appears to Be Engaged in Pleasant Conversation

M. C. Smith, Engineer in Charge of Filtration, Richmond, Va., reported on the successful results from the use of Nuchar at the Richmond plant. They had tried application of carbon to the raw water but had found it more economical to add it to the applied water. The Richmond basins being so large, little or no carbon would travel through to the filters. At Richmond the carbon is applied continuously and has made a marked difference in the quality of effluent.

M. M. Gibbons, Chemist in Charge of Filtration, Rahway, N. J., said that he could confirm the statement that it was essential that some carbon reach the filters. At his plant, Nuchar is applied at a point mid-way of the coagulation basin and with highly beneficial results. The taste problem at Rahway had been a severe one and about every process ever suggested had been tried as a corrective. So far they had found heavy prechlorination followed by powdered carbon, to remove the residual chlorine and such compounds as might not be destroyed by the

chlorine, to be the most dependable procedure. At times of severe conditions permanganate was added to the raw water in addition to the chlorine. The filtered water is again chlorinated lightly to insure its sterility when leaving the plant.

Chas. R. Cox, of the New York State Department of Health, reported that excellent results had been

Luncheon at Cobble Mountain Dam: C. W. Mowry and J. W. Ackerman Sitting in the Foreground. H. W. Hosford Standing

had from application of powdered carbon at 15 plants in New York State and complaining consumers were now well satisfied.

J. E. Kerslake, Chemist, Nicholas Hill, Engineers, New York, N. Y., reported his experience, wherein the application of powdered carbon (12 to 20 lbs. per m.g.) to a raw water had reduced alum consumption 40 to 80 lbs. per m.g. Pin-point flocculation had been prevented. He had found that in trying the carbon process one should not make any decision based upon a few hours of application. According to his experience a week or longer might be required before a valid decision might be reached.

R. G. Yaxley, Superintendent of Water Works, Waterford, N. Y., said that activated carbon had proved to be the only material to satisfactorily take tastes out of the Waterford supply, but he had not been able to do so with as little as 2 parts per million of carbon. Aeration was very helpful in summer but in winter they depended upon activated carbon. He had tried two brands of carbon and expected to try all of them to determine that best for his purpose. He had wondered what would happen when the carbon after a time had penetrated the filter bed to the gravel.

M. M. Gibbons said that they had been using carbon for 18 months at Rahway—20 parts per million having been used at times and the carbon had penetrated 24 inches into the sand bed. The sand by test could be freed of the carbon, if need be, by washing in an ordinary sand washer. They were not concerned about that matter.

A question was asked concerning possible application of powdered carbon to reservoirs. Mr. Stuart replied that such had been done at Bath, England, and also at Lancaster, Pa. He advocated mixing the carbon with lime for such application and using a carbon dosage of 10 parts per million. The lime had been used merely to produce more effective settling out of the carbon. Replying to a question as to mixing carbon in with alum in a solution tank, Mr. Stuart advised against the practice because the carbon seemed to loose its adsorbing properties somewhat after remaining for a period in the alum solution.

"Experiences with Ammonia-Chlorine Treatment at East Providence, R. I.," James V. Turner, Superintendent of Water Works, East Providence, R. I., and Chas. L. Pool, State Sanitary Engineer, Providence, R. I.

The joint paper by Messrs. Turner and Pool, covering several aspects of the ammonia-chlorine process for taste prevention, was read by Mr. Turner, who has had practical experience with this process at the East Providence plant for 18 months. The raw-water supply is taken from Ten Mile River, which is polluted somewhat and carries considerable swamp drainage. Its color ranges between 20 and 128 p.p.m., requiring coagulation with alum. Soda ash is added to adjust alkalinity just prior to filtration. Troubled with tastes from ordinary chlorination of the filtered water, ammonia had been added just ahead of the chlorine and with very satisfactory results. To secure a longer contact period than was available in the clear well, the ammonia and chlorine had been added to the settled water just ahead of the filters. The dosages had been —0.24 p.p.m. NH_3 and 0.75 p.p.m. chlorine during summer. In winter only 0.14 and 0.42 parts respectively had been required. The period in the filters and clear well insures a minimum of 20 minutes' contact before reaching the pumps. Residual chlorine being carried on top of the filters had been 0.4 p.p.m. and that in the effluent varied considerably.

The results, according to Mr. Turner, had been satisfactory, as indicated by cessation of consumer complaints. Bacterial tests had indicated the 20 min-

Truman Curry, Jr., Listening to War Experience of H. H. Hatch, Another ex-Soldier.

James V. Turner, Superintendent Water Department, East Providence, R. I.

ute contact to be sufficient with 0.4 p.p.m. residual chlorine on top of the filters even when there had been none in the filter effluent to speak of. The authors felt, however, that post chlorination should also be given to insure maximum safety or else the chlorine applied ahead of the filters should be more evenly distributed so as to maintain a slight residual through the filters at all times.

George E. Willcomb, Chemist in Charge of Filtration, Albany, N. Y., gave his experiences with the use of the ammonia chlorine treatment to eliminate bacterial after-growths which had appeared in a reservoir 3 miles from the Albany filter plant and likewise in the distant ends of the pipe system. They had applied a chlorine dosage as high as 0.85 p.p.m. in conjunnction with ammoniation and after a time the B. coli disappeared from the reservoir. With

the high chlorine dosage there had been no complaint of tastes.

Warren J. Scott, Chief Engineer, Connecticut State Department of Health, said that South Manchester had used the process as also had Bridgeport and Stamford. He referred to a small gravity supply which had been troubled from excessive chlorine dosage reaching the consumers as a result of fluctuating draft on the line to town. The use of ammonia ahead of the chlorinator had corrected the taste complaints due to super-dosing which occurred during low flows. The ratio of ammonia to chlorine had

Frank E. Winsor, Chief Engineer, Metropolitan Water Supply Commission.

Frank E. Waterman, Commissioner of Public Works, Providence, R. I.

been 1 to 2. He felt that there was a real need for a "Manual on Chlorination" in order that the newer aspects of chlorination might be better understood. He suggested that a committee might be named by the association to draft such a manual.

Chas. L. Pool, co-author of the paper presented by Mr. Turner, reported on studies made under his direction to determine what quantitative value should be given residual chlorine readings when using the ammonia-chlorine process as against that from ordinary chlorination, the length of contact period required, etc. The work had not been completed, but a 20 minute contact period seemed ample for East Providence conditions. In recording the residual chlorine a very long contact between the orthotolidin and sample seemed to be requisite. At times 35 minutes had been required to secure maximum color development. When using ammonia, he warned that the pH value and temperature of the water would have an important bearing on the length of contact period and residual chlorine required for efficient sterilization.

H. S. Hutton, of Wallace & Tiernan Co., called attention to the increasing use of ammonia-chlorine for controlling "slime" deposition and algae growths —especially in paper mills. He also suggested that in instances where chlorine did not produce tastes from products already in the water, but where the effectiveness of ammonia in preventing chlorinous tastes and for holding residual chlorine throughout the pipe system was desired, it would be feasible to add the chlorine first and ammonia thereafter. The chlorine alone would more quickly destroy the bacteria and the ammonia could be applied as the water leaves the plant.

In reply to a question, **L. H. Enslow** confirmed Mr. Hutton's suggestion, but only with the clear understanding that the water chlorinated would not contain materials of a taste producing nature. In other words, a fairly pure water might be subject to no tastes other than that of the chlorine added. In that event the water could be chlorinated and later ammoniated to eliminate the chlorine taste and at the same time allow a heavier chlorine residual to be carried and sustained in the system. At Richmond, Va., something of that sort was being done. The raw water heavily chlorinated with chlorine alone was then coagulated and passed through the basins, carbon was then added ahead of the filters. The effluent received an additional dosage of chlorine and ammonia and it had been possible to deliver a taste free and sparkling product to the consumers which carried 0.2 p.p.m. or better residual chlorine. Dead end tastes had been practically eliminated and no complaints had been had concerning the high chlorine content of the water. Other instances were on record wherein the water had been first superchlorinated and ammonia added to render the excess chlorine non-taste producing.

"Aeration in Water Treatment," Herman B. Anderson, Vogt Bros. Mfg. Co., Louisville, Ky.

Reviewing the several advantages resulting from aeration of water, Mr. Anderson stressed taste and odor removal, carbon dioxide and hydrogen sulphide elimination, oxidation of iron and manganese and the efficient distribution of chemicals applied to the water ahead of aerating devices. He mentioned the several types of aerating devices, the most recent of which had been the development of the "Aeromix" unit which operates on the diffused air principle. In this aerator the air is sucked into the throat of the aerator-head in the form of finely divided bubbles which create rapid mixing of chemicals with the water and thereafter is released to sweep out odors, carbon dioxide and other gases. The "Aeromix" operates on a head of 8 ft. Several successful installations had been made—the largest being three 10 million gallon units at the Nashville, Tenn., filter plant. Mr. Anderson cited cases wherein the "Aeromix" had cut operating costs materially—Lynchburg, Va., being an outstandnig example where formerly an available head of 58 ft. had to be dissipated through aerator nozzles and repumping the aerated filtered water had been expensive. A saving of $16,000 spent per year for electric power had resulted since the installation of an "Aeromix" which had also improved coagulation and had made it possible to use water from a lower depth in the raw water reservoir.

Herman Anderson, of Vogt Bros., Louisville, Ky., and George Wirtz, of Atlas Mineral Products Co.

Robert Spurr Weston, Consulting Engineer of Boston, Mass., was requested to discuss Mr. Anderson's paper. He reviewed the several classes of substances which were responsible for odors. The gases and the more volatil oils he had found subject to removal by aeration, but when it came to the ethereal oils from most algae or vegetation or heavy oil from crude oil, coke by-product plants, etc., some form of chemical treatment or removal by adsorption was usually necessary. He called attention to the successful use of absorbent clay at the Chester, Pa., filtration plant where oily tastes had been a baffling problem prior to the use of the clay. His experience with powdered activated carbon at Easton, Pa., where the water was highly colored and clear, had shown that a dosage of

R. N. Soule and F. H. Kingsbury of the Massachusetts State Department of Health, and C. P. Moat of the New Hampshire State Department of Health, Snapped in a Pretty Spot

but 4 lbs. per m.g. had proven an appreciable aid to coagulation.

R. G. Yaxley had observed that aeration at Waterford had caused a drop in soap hardness of the water which could not be accounted for by the removal of carbon dioxide alone. There had been as much as a 30 per cent hardness reduction but he had not found anyone who could satisfactorily explain the reason for it. Waterford takes water from the Hudson River above Troy and the river is contaminated with paper and pulp mill wastes—including sulphite digester liquor.

George W. Fuller, of New York, reviewed some of the earlier studies in aeration and the development of theories by the late Professor George Whipple, who had dropped water in various sized droplets down the stairwell at Brooklyn Polytechnic Institute in order to catch samples after various lengths of travel and surface exposure. He said that air blowing aeration had been used at Springfield in 1903 and this was followed by double filtration. He referred to the studies made by himself also on the Catskill supply which had led to the adoption of nozzle aeration a few years later.

E. L. Bean, Chemist Scituate Filtration Plant, Providence, R. I., said that they had found it expedient to draw water from the bottom of their reservoir in order to avoid algae and to put to good use the iron and manganese present as "nature-given" coagulants. Chlorinated ferrous-sulphate (chlorinated-copperas) was being added ahead of the nozzle aerators to make up the deficiency in the "free" coagulant. They had not found the aerators effective in oxidizing the iron and manganese present, but it did give an average of 70 per cent carbon-dioxide removal. Excess chlorine served to oxidize these and lime added caused rapid coagulation of all iron and manganese present. Before the lime application for coagulation they had aerated the filtered water, using a varying head between 3 and 8 ft. to operate nozzle aerators. This practice had reduced the carbon dioxide by 50 per cent and somewhat better at times.

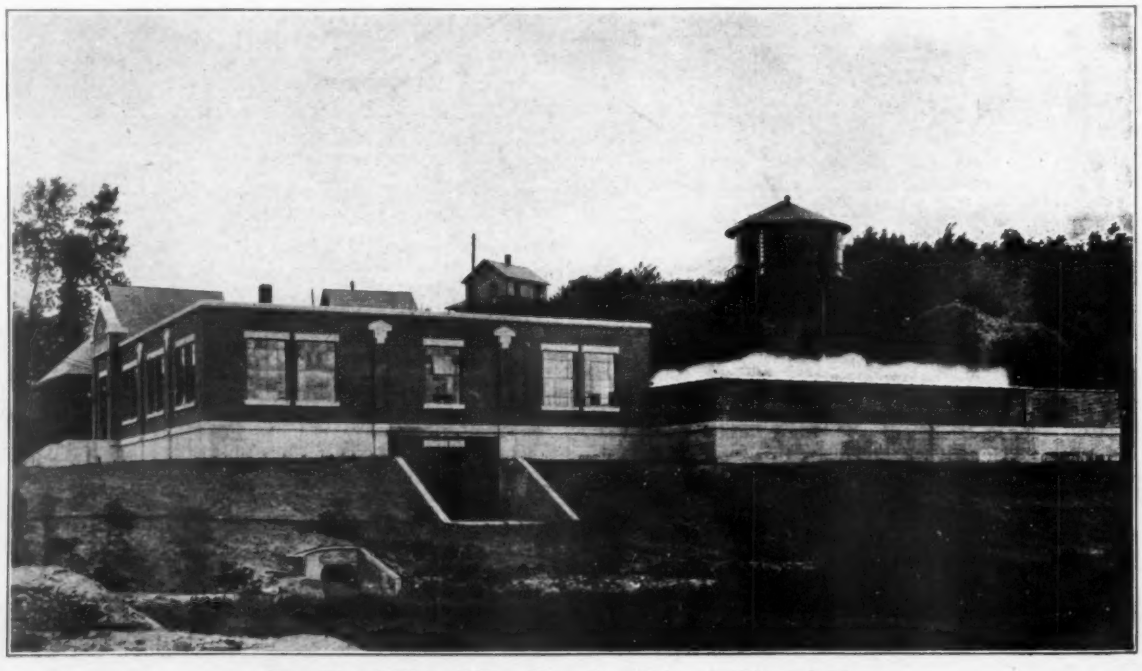
Quality of Impounded Waters

The forenoon of Friday, Sept. 30, was devoted to two papers treating quality of impounded waters and one depicting improved mechanical conditioning or flocculation of coagulated waters.

President Geo. C. Brehm, presiding, announced the fact that Mr. Robert Spurr Weston had been suddenly called home on account of the death of his daughter. The members present were asked to stand silent with bowed heads for a minute, as an expression of sympathy before proceeding with the papers.

"The Quality of Impounded Waters," Harrison P. Eddy, Consulting Engineer, Boston, Mass.

In Mr. Eddy's absence his paper was read by E. Sherman Chase of Metcalf and Eddy, Engineers, who said that many things had a bearing on the quality of impounded waters. Geological conditions would have a bearing on mineral content, including manganese, iron and hardness. Topography would have a bearing on color and turbidity; the former coming from swampy areas and the latter from barren slopes or plowed ground. Shape of reservoir



The Five Million Gallon Filtration Plant of Chicopee, Mass.

Interior View Filtration Plant of Chicopee, Mass.

and wind action might have a great deal to do with shortcircuiting and rapid travel of pollution to intakes. The most satisfactory quality of stored water had come from reservoirs with steep slopes and small area. It has been admittedly difficult to predict in advance the quality of water from impounded supplies, and although color decreased usually with time, sunlight and natural coagulation, that had not always been the case. Large reservoirs suffered less from algae growths generally and water from new reservoirs generally had considerable iron, manganese, color, carbon dioxide and frequently hydrogen sulphide was also encountered in the lower strata. Examples of this were found at Providence, R. I., and Wanaque, N. J. The preparation of reservoir sites in modern practice, said Mr. Eddy, consists of removal of trees and marginal grubbing of the shore line. Stripping is no longer considered advisable because expense involved is too great for the advantage gained.

E. C. Craig, Superintendent Scituate Division, Providence, R. I., Water Department, said that the public is demanding a better quality of water than ever before. At Providence they had been faced with the problem of removing manganese, iron, color and hydrogen sulphide from the stored water. The impounded water showed little or no improvement in quality with the passing of time. They had finally decided to draw from the lowest intake (15 ft. above bottom) and secure a cooler water (55° F.) free of algae. At the same time the sulphide manganese and iron content was there the greatest but these were oxidized by aeration and chlorination and put to work for their coagulant value. Chlorinated ferrous sulphate and lime had replaced alum in coagulation practice—the high pH value of 9 to 9.5 serving to completely precipitate the manganese and correct the aggressiveness of the very soft water.

Stephen DeH. Gage, Consulting Engineer, Providence, R. I., said that on watersheds evergreen trees kept the ground more open and conserved precipitation more satisfactorily because these gave off less water through transpiration than did deciduous trees. Leaves also discolored the water more than needles from evergreens do.

F. A. Kingsbury, of the Massachsetts State Health Department, cited a case wherein wind effect had caused pollution to traverse a reservoir to the intake within 1.5 days where theoretically 300 days should have been required.

"Manganese in Impounded Waters," Robert Spurr Weston, Consulting Engineer, Boston, Mass., and A. E. Griffin,* Wallace & Tiernan Co., Newark, N. J.

Mr. Weston's paper was read by F. W. Gilcrease of Weston & Sampson, Engineers. Mr. Weston presented records showing the variations in manganese content in the Wanaque Reservoir of the North Jersey District Water Supply. The reservoir had been placed in service in March, 1930, and at present 75 m.g.d. was being supplied, but 100 m.g.d. consumption was expected shortly. The catchment area covers 94.4 square miles with a calculated yield of 1.1 m.g.d. per square mile. The water being corrosive required adjustment with lime applied a short distance below the dam to raise its pH value of 6.8 to one of 8.8. A coating of manganese is being deposited on the interior walls of the steel aqueducts.

The water is chlorinated and the manganese interferes with the orthotolidion test, requiring the daily determination of "blanks" on samples of raw water so treated as to insure oxidation of the manganese. The latter had varied between 0.03 p.p.m. at the surface to 4.75 p.p.m. in the bottom water 80 feet below surface. Reservoir overturn results in marked increased manganese content of the upper strata. The manganese problem had apparently become more widespread than formerly had been observed. The water leaving Wanaque reservoir during 1930 had

carried between 0.0 and 2.4 p.p.m. manganese and in 1931 contained between 0.09 and 1.56 p.p.m. Mr. Weston said that the major source of the manganese was without doubt the result of the solution of manganiferous and iron bearing deposits brought about by bacteriological decomposition which was responsible for a reduction of manganic compounds ordinarily insoluble to the soluble manganese and ferrous salts.

E. L. Bean, Chemist, Providence, R. I., Water Department, said that water had been drawn from near the bottom of the Scituate Reservoir continuously since July, 1931, with no apparent diminution in manganese content and that had been unexpected. It appeared that the manganese was being fed in from the earth and as the water level (head) was drawn down, more seepage would enter from the bottom bringing its quota of iron, manganese and sulphide. As little manganese as 0.15 p.p.m. in the filtered water entering the aqueduct at Providence had caused considerable difficulties when precipitated therein. The quantities in the Wanaque water could be expected to give even more trouble. Application of the ammonia-chlorine treatment to the filtered water had caused the manganese deposits to break loose or slough off of the pipes and aqueducts.

Warren J. Scott said that certain waters under his observation had shown an apparent but erroneous residual chlorine content of 0.3 p.p.m. in which cases manganese had been almost wholly responsible. To determine the false color due to the manganese oxidized by the chlorine, the procedure of boiling off the chlorine and testing the samples for manganese "blank" with orthotolidion, as suggested by Enslow as the only available practical method of differentiation, had been used to arrive at the actual chlorine content.

George D. Norcom of the Federal Water Service Corporation, New York, N. Y., said that manganese difficulties had become widespread. Iron bacteria seemed to thrive in manganese in pipe lines, filters, etc. The interference of manganese with the orthotolidion test for chlorine was serious and a specific test for chlorine alone was badly needed.

F. W. Gilcreas reported that slow sand filters seem to remove about 90 per cent of the iron and manganese, leaving 0.1 to 0.2 p.p.m. manganese in the effluent. No chemical had been added prior to filtration.

"Mechanical Conditioning of Treated Waters," R. S. Rankin, Engineer, The Dorr Company, New York, N. Y.

Mr. Rankin reviewed briefly the various types of mixing devices employed to assist coagulation of chemically treated waters and listed the good features and shortcomings of each type. In the rotating verticle paddle type of mixer, short-circuiting resulted unless these were operated in series. The most recently developed coagulation accelerator consisted of horizontal paddles placed in a basin with the rotating center shaft lengthwise or crosswire. That device had been developed at Richmond, Va., and named the "Flocculator" because its function was to do more than that of a mixing device. Two other installations were under way and a year of operation at the Richmond plant had demonstrated the several valuable features of the device.

To secure most effective and economical usage of coagulants it appeared that rapid mixing for 1 to 5 minutes to distribute the chemical was the first requisite. To secure the best type of precipitate or "floc," the short rapid mix should be followed by a slow motion of the water sufficient to maintain suspension and produce long travel of "floc" particles through the water—the increased travel of the "floc" giving an increased sweeping out effect to remove impurities. Such a treatment might be called conditioning and should be maintained for 30 to 60 minutes when alum or iron compounds are employed and probably longer in water softening practice. Proper flocculation reduces the required sedimentation period to a minimum. The "flocculator" requires no head for operation; produces a more uniform sized floc which settles more promptly than variable size floc; is not affected by change in rates of flow through the plant; is adaptable to existing plants; requires low power for operating and above all effects economies in chemical consumption. It will fit into existing sedimentation basins as was the case at the Richmond, Va., plant. Mr. Rankin said that coagulants might be reduced by as much as 30 per cent with the flocculator and that power requirement would not exceed 6 k.w.h. per million gallons when providing a 60 minute period through the flocculator. 1 cent per k.w.h. the cost would be 6 cents per million gallons.

At Richmond 4,000 lbs. less of alum per day had been used during 1932 with the flocculators in service than in 1931 without them. The average saving of 1.39 grains of alum per gallon—roughly a 40 per cent reduction—had been observed during an eight month period in 1932.

Having had considerable contact with the Richmond filtration plant, **L. H. Enslow** reported that the results secured with the flocculators there had struck him very forcibly. The saving in chemicals and the material improvement in the rapidity and effectiveness of clarification would make it feasible to operate the plant with one-half the available coagulation basin capacity. Mr. Rankin had assigned no value to the principle of floc return or recirculation by the paddle wheels sweeping near the bottom toward the inflowing water. The recirculated floc and the "barrel-rolls" given the water and swirling eddy currents created at the surface had an appeal. The matter of major interest had been the greater ease of handling the James River water impregnated with tannery and paper mill wastes. That this had been accompanied by a reduced operating cost was even more interesting to water works men and particularly in these days.

The Richmond plant was being operated on about a 100 per cent ideal plan. The steps involved consisted of heavy prechlorination, alum addition, rapid mixing (baffled chamber), flocculation, sedimentation, activated carbon application ahead of filters, post chlorination and ammoniation, and finally pH adjustment by lime dosage. Mr. Smith, Engineer of Water Supply at Richmond and the inventor of the flocculator, deserved a deal of credit for the up to the minute improvements at the local filtration plant.

Chicopee, Mass., has a new and modern filtration plant of 5 m.g.d. capacity which was inspected by a number of the members of the N. E. W. W. A. during the Springfield convention.

*Until recently Chemist, North Jersey Water Supply, Wanaque, N. J.

The Recently Completed Treatment Plant at New Canaan, Conn., Employing Mechanical Aeration. Inspected by Members During a Downpour of Rain.

MEETING OF NEW ENGLAND SEWAGE WORKS ASSOCIATION

THE New England Sewage Works Association held its Fall meeting at the Hotel Stratfield in Bridgeport, Conn., on Oct. 17. The meeting was opened with a brief address by E. T. Buckingham, Mayor of Bridgeport and member of the Tri-State Pollution Commission. It was probably as the result of his experience while serving on this commission that led him to say that "promoting sanitation was difficult because the public was, as a rule, suspicious as to the motive behind such projects." He also said that criticism of public-works projects was the thing to expect because most taxpayers could find fault without difficulty and always knew a better way of doing things than did the city officials—including mayors.

Association Addressed by Professor Winslow

A feature of the meeting was the dinner address delivered by Professor C. E. A. Winslow of Yale University, who reviewed the history of sewerage developments and progress up to the present day. Professor Winslow referred to the early Roman and Parisian sewers which in reality were only drains and said that not until 1880 had domestic sewage been permitted to be discharged into the Paris sewers. Sewage treatment began apparently with the removal of solids by chemical precipitation. The idea had been chiefly one of recovery of manurial constituents thereby and that no less than 417 patents had been issued covering numerous chemical processes during the 20-year period 1856-1876. In 1893 Cameron evolved the septic or liquefying tank and the following development of consequence had been the tank of Imhoff in 1900 which represented the first scheme for separating sedimentation and liquefying operations. Finally, the system of complete separation by the separate digestion scheme had been the most recent improvement.

In connection with the oxidation of organic matter irrigation schemes starting in 1859 represented the first development. It was thought that the growing crops did the purifying but that Franklin in England in 1870 proved the soil action rather than the crop to be responsible. It was at the Lawrence, Mass., Experimental Station in 1887 that the basic discovery was made that the soil effect was in truth a bacterial phenomena. Dibden in England later developed the contact bed and Stoddard went a step further and developed the sprinkling filter. The activated sludge process was accidentally discovered at the Lawrence Experimental Station but was developed to a practical degree in England.

Professor Winslow reviewed the major present trends in sewage treatment practice involving more mechanically operated plants and had noted with interest the returning of chemical precipitation now being practiced on a much better controlled basis which entailed the use of moderate dosages of chemicals such as practiced at Dearborn, Mich. The advances in chlorination, particularly in chlorination of crude sewages for preventing odor nuisance and safeguarding structures had been an important step forward. He stressed the fact that sewage treatment must be considered a means to an end and that it was the duty of the engineer to provide treatment to the practical extent required and no more. The economics of sewage disposal were of primary importance and he felt that "the cloth must be cut to fit the suit" in each instance—anything more was wasteful of taxpayers' money. He thought the idea of recovery of products of value from sewages and industrial wastes should not be given up and that chemists attacking the problem could probably give us the answer. He felt that the scheme of setting up river boards to decide the extent of treatment required for given streams to be the most practical means to reach the desired end, with the greatest benefit to all and the least expense.

Professor Winslow was given a rising vote of thanks for his very excellent address.

The R. F. C. and Public Works Aid

J. Frederick Jackson, State Chairman of the National Committee for Trade Recovery, reported that there had been considerable confusion and misunderstanding in the R. F. C., concerning the definition as to what were self-supporting public works. Only within the past two weeks had the important decision been rendered which took the front footage assessment on properties out of the category of taxation and considered it as a legitimate service charge to cover costs of operation and self liquidation of the project. That ruling would place municipalities and private companies in a much better position to secure R. F. C. aid in connection with sewerage developments. As the result of past experiences he urged the cities to draw up preliminary plans and specifications for presentation to one of the Regional Advisory Boards for forwarding to the R. F. C., prior to complete preparation of plans. The work of the R. F. C. should be speeded up as a result of the recent establishment of engineering advisory committees

in 13 districts. These committees would be able to speed up the handling of applications for loans and had been set up to assist municipalities in securing loans with the least possible delay.

Technical Sessions

President Roy S. Lanphear, Presiding

"Rating of Sewage Treatment Plants According to the Adequacy of Operating Data," by Wellington Donaldson, of Fuller and McClintock, Engineers, New York City.

Mr. Donaldson advocated the establishment of a scheme for rating sewage treatment plants which was to be based on the thoroughness and completeness

W. J. Scott, Chief Engineer Connecticut State Department of Health. The Organizer of the New England Sewage Works Association.

Stuart E. Coburn of Metcalf & Eddy, Engineers. First President of the New England Sewage Works Association.

with which operating records and data are kept. Plants would receive a "D" rating for example if the simplest records were kept. With increasing completeness of operating records, cost data and analytical findings, the ratings would be raised to the maximum which would be "A" rating. The operator at a plant receiving a "B" rating would have to be capable of conducting laboratory tests, such as suspended solids and the B. O. D. determination in addition to the simpler tests. Such would be possible if the operator had attended one or more of the Operators' Short Courses now available in so many States. The keeping of accurate operating cost data and power consumption was one requisite to the "A" and "B" ratings.

Mr. Donaldson said that the rating system was proposed as an incentive to encourage improvements and better plant operation over the country and recommended that a committee be named, to represent the several associations comprising the Federation of Sewage Works Associations, for the purpose of developing rating standards.

W. R. Copeland, Sanitary Engineer, State Water Commission of Connecticut, said that the set-up suggested seemed a bit too formidable for the present status of sewage treatment. He felt, also, that plant should be rated "A" regardless of its size, type or limitations just so long as the efficiency of that plant was being maintained and the essential records were being kept. He agreed that the keeping of daily records was of fundamental importance in sewage treatment practice.

L. H. Enslow said that a scheme of rating plants should prove very valuable. That an operator might make good use of the rating scheme as an argument as to why he should attend a short course or be given certain needed equipment which would make it possible to secure the next higher rating for the local plant. The details of the rating procedure suggested by Mr. Donaldson might be revised and plants rated as B-100, B-80, B-60, etc., which would signify that the plant was in the "B" grade, but that the records were being kept up to 100 per cent, 80 per cent, etc., of the stipulated requirements set for plants in grades "A" to "D."

E. M. Ellsworth, of Metcalf and Eddy, Engineers, Boston, Mass., said that a natural question would be "does the keeping of more adequate records pay?" In several instances properly kept records have been valuable in fighting law suits and have also been effective in reduction of operating costs.

Mr. Donaldson cited the use of the simple moisture determination on solids at the New Haven plant. The use of that test had led to the production of a sludge of greater density for barging to sea and thus had saved a great deal of money by reducing the number of bargings per week to dispose of the undigested sludge.

W. J. Scott, Chief Engineer, Connecticut Department of Health, said that it was of primary importance in any rating scheme to include a provision relative to the use of the bypass at sewage treatment works.

Report of the Committee on Sewage Sampling

The Committee on Sewage Sampling distributed a very complete report with recommended sampling procedures. This report was discussed at some length by **E. S. Chase** and was referred back to the committee for some further revision and additions. Mr. Chase thought that one sewage or effluent sample might be composited from three individual samples collected at pre-determined hours in order to secure a sample which would represent average con-

Secretary F. W. Gilcreas of Weston & Sampson, Engineers, Boston, Mass.

Roy S. Lanphear, President of the Association, Is Supervising Chemist Sewage Treatment Works of Worcester, Mass.

ditions of flow and sewage strength during the entire day and thus avoid the burdensome hourly sampling.

Sewage Solids Incineration Discussed

A paper scheduled to be presented by **M. J. Blew** of Philadelphia, on **"Observations on Incineration of Sewage Sludge"** was not received in time for reading.

President Lanphear explained that the author had been ill and thus the preparation of the paper had been delayed. He called on L. H. Enslow to contribute something concerning sewage solids incinera-

tion. Mr. Enslow referred to the increasing practice of incineration of coarse and fine screenings without odor nuisance resulting and at a cost not at all prohibitive in properly designed and operated incinerators. The practice of screenings incineration in Westchester County, N. Y., had been particularly impressive and efficiently done. The incineration of sludges following dewatering on vacuum filters seemed fair to prove a practical and economical procedure as evidenced by the results secured at Chicago. Rather than report in detail he would prefer to have the chairman call on Mr. Flynn of the Oliver United Filter Co. to report from first hand observations.

The Chair called on **E. D. Flynn,** who stated that mixed crude solids and activated sludge had been conditioned with ferric chloride and dewatered on vacuum filters of the drum type (11x16 ft.) to produce a cake with 76 per cent water content and this cake after passing through a rotary indirect drier had been incinerated. The first 15 hour run had shown that the sludge after drying would burn without odors and produce sufficient heat for the continuous drying process. The tests had been continued until 67 tons of sludge cake (76 per cent water) had been incinerated without requiring auxiliary fuel beyond the first two hours of the test. The dried sludge had a heat value of 6,000 to 7,000 B.t.u. per pound. Several incinerator firms were working to perfect an efficient unit to burn sludge and something worthwhile was expected to develop.

W. R. Copeland said that the Westchester incineration plants had been operated very efficiently and in consequence no odor nuisance had been produced. Continuous operation of the incinerators would produce practically no chance of odor nuisance. Intermittent operation required care in starting and closing down the incinerators if odor nuisance was to be prevented.

Mr. Flynn remarked that odors would come from the drying process unless a temperature under 300° C. was maintained through the drier. The "flash" combustion in the incinerator precluded possibility of scorching and odor nuisance thereafter.

W. Donaldson said that incineration of fresh solids would eliminate the need for digestion tanks and sludge beds. At Hagerstown the scheme would be to dewater fresh solids plus activated sludge by conditioning with lime and paper pulp. Eventually, the filter cake from the Wright filter would be incinerated if plans materialized.

Mr. Flynn remarked that all in all the most satisfactory and economical scheme seemed to point toward sludge digestion with gas utilization and dewatering and incineration of the digested sludge. In that way the heat balance was not disturbed and the digesters served as sludge storage between continuous runs of the dewatering and incineration process.

Chester Proudman, Superintendent of Sewage Treatment Works, New Canaan, Conn.

Inspection Trips

Inspection trips were made to the new treatment plant at New Canaan, Conn., where mechanical activation is employed; to the separate sludge digestion plant at Norwalk, Conn., and to the Bridgeport Screening Stations, where fine disc screens are employed.

The meeting closed with the annual dinner at which Professor Winslow delivered the address already referred to in this report.

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President Hoover Addresses the American Public Health Association

In an address delivered at the opening session of the Annual Convention of the American Public Health Association in Washington, D. C., on Oct. 24, Herbert Hoover, President of the United States, pledged his support in matters pertaining to the advancement of public health and assured Government aid wherever feasible and in his power to provide it.

High-Lights from President Hoover's Address

"Fifteen years ago, almost to the day, I had the pleasure of addressing the American Public Health Association. Difficult as conditions were for the civil populations of all the nations in the war area, they would have been infinitely more difficult had it not been for the modern organization of protective health services and the scientific understanding of sanitary measures necessary to prevent and check such epidemics of communicable disease as had always, in earlier wars, swept over the nations.

"My next major contact with your body was during the Mississippi River flood in 1927. In traveling over the region affected by those floods, from the lower Ohio River Valley to the mouth of the Mississippi, and organizing the measures of the Federal Government to overcome that calamity by rescue from flood and re-establishment of 1,000,000 of our people in their homes, it was obvious that sanitation and health control were imperative to prevent the outbreak of devastating epidemics. In this emergency the public health agencies and the allied groups were indispensable, and I took the liberty of mobilizing the energies of your members. They rose to the situation and by their skill and promptness prevented a very serious loss of life.

"Every county in the United States should set up for itself, as its minimum health organization, a unit consisting of a doctor, a sanitary engineer and a trained nurse. These units were established in 100 counties in the flood area, and the extraordinary successful results of their work confirmed the wisdom of the plan. By every means within my reach I have ever since promoted the idea of establishing these units in every one of our 5,000 counties in the United States. Although I am generally opposed to Federal subsidies to the States, yet I have regarded contagion as an interstate question and have recommended Federal contributions to such a universal service.

"I am in favor, as a constructive measure of public economy, of a program to be carried out on such wise lines, to reduce contagious disease with Government encouragement.

"The well-being of the future generations of our children, the building up of safeguards around the home and the health of the parents and of the growing family, which will contribute to the production of a healthier and more virile race and to the preservation not only of the treasures of childhood as a whole, but also to the preservation of those precious exceptional children, whose birth cannot be predicted of any class or moment, and from whom comes the leadership of our democracy, to which they rise through the free channels of opportunity in our country."

GRAVEL-WALL WELLS ON SHORE OF LAKE MICHIGAN

By N. F. YONKMAN

Engineer—Commissioner of Water Works, Grand Haven, Mich.

N. F. Yonkman

GRAND HAVEN, Mich., although having Lake Michigan on the west side and Grand River on the north and east sides, has always spent considerable sums of money on its water supply. Grand Haven has a winter population of 8,345, which is greatly increased by summer residents. The fact that Grand Haven is a summer resort is one of the main reasons why a sufficient and good tasting water supply is especially desirable. Deep wells are impossible in Grand Haven, because solid clay is found at a depth of 16 ft. in the eastern part of the city and at a 30 ft. depth on the shore of Lake Michigan.

From 1884 to 1928 the city's supply came from shallow wells, some in the eastern part of the city, some along the river bank near the municipal light and power plant and some on the shore of Lake Michigan. In 1913 36 six-in. Cook points, spaced 9 ft. apart, were driven on the shore, to a depth of 18 ft., right at the water's edge, the lake elevation being 581.2. These points gave a variable supply of water, as high as 2,000,000 gallons a day when the lake elevation reached 582.0 and the points were new and clean and a few times dwindling to almost nothing, as in January, 1916, and in February, 1923, when ice bergs covered the sandy beach and extended for a quarter of a mile out into the lake. Coincidentally the lake level had dropped to elevation 578.8.

In January, 1921, an infiltration line consisting of 400

Filtration Plant of Grand Haven, Mich.

lin. ft. of 36 in. concrete tile was laid paralled to the shore, the invert being at elevation 575.3 and the lake level at 579.9. The bottom half of the tile was encased in gravel and the top half of the joints cemented.

This pipe line gave lots of water as long as the lake level did not fall, but the lake level continued to drop and the water receded from the 6 in. points and the infiltration line. In 1923, two intakes, each 250 ft. long, had to be installed in Lake Micthigan and connected with the infiltration line. The amount of chlorine applied had to be immediately increased. In January, 1926, although the lake level had lowered to 577.3 (the lowest since 1860), the lake intake prevented a water shortage.

One of the Wells, Showing Concrete Cap and Steel Cover

But in July, 1926, the water developed a bad taste and minnows were found in the faucets.

In 1927 the construction of a rapid sand type filtration plant of 2,000,000 gallons a day capacity was begun. It was completed in May, 1928, at a cost of $126,420.39. Instead of using lake water, an intake was installed in the river at a point between the city and Lake Michigan. The result was a raw water contaminated by the domestic and industrial sewage of Grand Haven. A study of the tabulated data will show the marked difference in quality between the river water used from May 10, 1928, to Feb. 17, 1932, and the supply from the new wells now in use.

In 1931 the amount spent for chemicals was $2,854.39 and the amount of water pumped was 197,242,600 gallons. The water was warm in the summer, entering the filtration plant during July, 1931, at an average temperature of 80° C. The taste became unbearable to many of the citizens and many private wells were driven, the water revenue dropping 10 per cent.

Grand Haven is governed by a Council and has a City Manager.

The writer decided to run for the council in 1930 on a "better water" platform and was elected in the primary from among five candidates. The council consists of a mayor and four aldermen. But a majority vote of aldermen favoring a new water supply was not secured until 1931, when a new mayor and two new aldermen were elected and joined forces with the writer. Incidentally the writer, who had been assistant engineer with the Ottawa County Road Commission since 1922 made it his special business to read every issue of the

local daily newspaper since January, 1911, and also every proceeding of the council for the same twenty-year period and thus get the background of the various changes in the water supply that had been made from time to time.

The New Water Supply

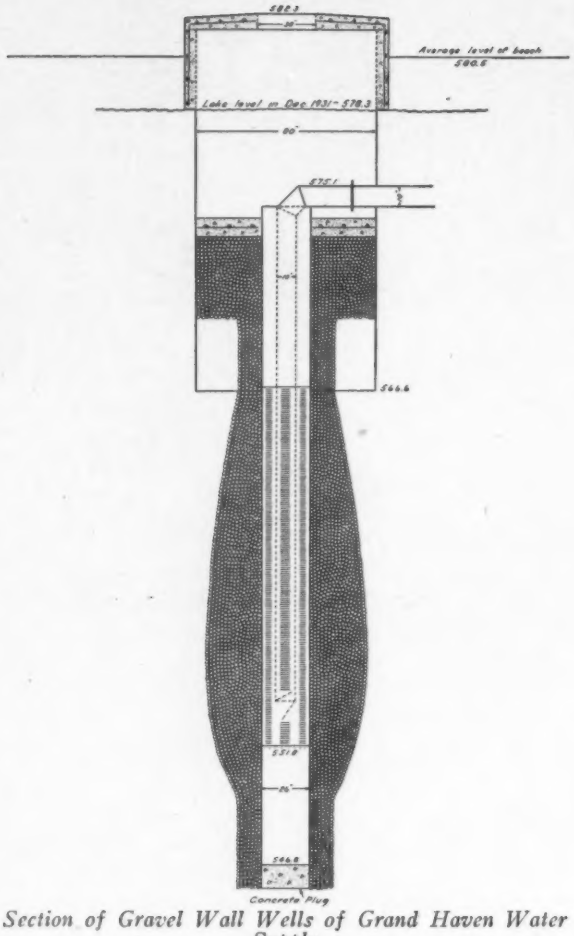
It so happened that the lake level had dropped to 578.3, a drop of 4 ft. from August, 1929, and a vast expanse of beach was uncovered, leaving the 400 ft. of 36 in. tile line and the original 6 in. well points about 150 ft. from the water's edge. Knowing that these two previous installations had worked successfully whenever the lake rose and flooded them, it was decided to construct enough gravel-wall wells parallel to the lake shore to furnish 2,500,000 gallons a day. Realizing that only shallow wells could be dug, it was agreed that suction piping should connect the new wells to a 30-ft. diameter collecting well built in 1913, from which the water flows through 3,200 lin. ft. of 16 in. cast iron pipe to the water works and the filtration plant. The invert of this 16 in. line is at 575.2 and it and the 30 ft. well were designed by the late Gardner Williams.

A contract was awarded the Harmon-Ness Company of South Bend, Ind., in June, 1931, and the new wells were put into service on Feb. 17, 1932. The total cost was $28,000, including a 15x15 ft. concrete and brick pumphouse, containing two 1.5 m.g.d. capacity double suction centrifugal pumps and a 3 H.P. vacuum pump, and a one-story building of concrete and brick over the old (1913) collecting well. Both buildings were constructed by the city. The two pumps are set at elevation 574.5 or about 4 ft. below lake level of present date.

The wells were built about 25 ft. from the water's edge, but the lake has lowered until they vary from 101 to 153 ft. from the lake. This leaves the old 6-in. points and the 36-in. infiltration line 250 ft. from the water's edge. But the wells are functioning perfectly, the maximum demand during June, 1932, being 1,500,000 gallons per day. When the lake comes up again, as it always has, the yield should easily reach between 3,000,000 and 3,500,000 gallons per day.

COMPARISON OF OLD AND NEW WATER SUPPLY, GRAND HAVEN, MICHIGAN, 1932.

	River Water		*Well* Water		
	January	February	March	April	May
Plant Data:					
Gallons filtered	5,680,800	4,956,400	11,235,300	12,448,000	18,172,600
Per cent for washing	1.8	2.3	2.3	1.5	2.7
Filter runs (hours)	126	76	109	143	86
Loss of Head (Feet):					
Initial	.3	.5	.3	.3	.4
Final	7.6	4.0	2.7	3.0	6.6
Chemical Application:					
Alum (gr. per gal.)	6.3	6.7	None	None	None
Lime (gr. per gal.)	1.8	1.9	None	None	None
Chlorine (p. p. m.):			...	...	...
Raw water	1.65	1.69	.34	.34	None
Filtered water	.58	.56	.48	.48	.41
Raw Water:					
Color	...	35	18	...	...
Turbidity	37	29	2	3	2
Alkalinity	155	167	163	...	...
Incrustants	120	125	31	...	...
Total hardness	275	292	194	...	...
Oxygen consumed	8.7	8.5	...	...	1.5
Temperature	37° C.	34° C.	46° C.	46° C.	47° C.
Filtered Water:					
Color	...	15	5	...	...
Turbidity	...	...	0	0	0
Residual chlorine	.33	.31	.30	.28	.23
Alkalinity	134	143	159	162	161
Incrustants	150	163	37	29	27
Total hardness	284	306	196	191	188
Oxygen consumed	5.5	5.1	...	...	...
pH	7.3	7.3	7.5	7.5	7.6
Bacteria per cc.—48 Hours—20° C.:					
Raw (average)	12,721	14,297	16	20	20
Raw, max.	33,000	44,000	75	140	350
Filtered	48	13	186	35	31
Disinfected	13	7	13	2	4
Bacteria per cc.—24 Hours—37° C.:					
Raw	1,434	1,008	2	2	3
Settled	29	27	...	...	...
Filtered	11	7	14	9	4
Disinfected	11	11	1	.3	.7
B. COLI—Raw:					
1 cc. 24 hours	41/62	12/30	0/62	0/60	0/60
1 cc. 48 hours	51/62	23/30	1/62	0/60	0/60
10 cc. 24 hours	58/62	27/30	6/155	2/150	1/150
10 cc. 48 hours	61/62	30/30	20/155	5/150	7/150
B. COLI—From Mains:					
10 cc. 24 hours	0/105	0/98	0/59	0/38	0/47
10 cc. 48 hours	0/105	0/98	0/59	0/38	0/47
B. COLI—Disinfected:					
1 cc. 24 hours	0/51	0/50	0/61	0/59	0/57
1 cc. 48 hours	0/51	0/50	1/61	0/59	0/57
10 cc. 24 hours	1/255	2/250	0/304	0/290	0/285
10 cc. 48 hours	69/255	37/250	6/304	0/290	0/285
E. M. B.	0/69	0/37	0/6	.....	.....
Replanting	0/69	5/37	0/6	.....	.....
B. Coli Index (raw)	33,226	24,563	4.5	1.33	.446



Section of Gravel Wall Wells of Grand Haven Water Supply

Six wells were dug, five along the lake shore and one 90 ft. inland. Each well has an outer casing of 80 in. diameter, the depths varying between 10 and 15 ft. Each well is capped with a steel plate having a 30-in. opening on an 8-in. riser, this opening also having a steel plate fastened by 26 bolts. The remainder is covered by 6 in. of reinforced concrete, extending to the lake level at elevation 578.3. No lake water can enter the wells.

The water enters each well through a 26-in. diameter Lane-Bowler "ascoloy" screen which is surrounded by 24 in. of fine gravel. A 10-in.drop pipe, 21 ft. long, is hung in each well and connected to a 16-in header running to the pumphouse. The top of each drop pipe varies from 3 to 4 ft. below the present lake level. This means that water can be pumped from as low as elevation 556.3. One million gallons a day can be pumped with the draw-down elevation remaining stationary at 566.5. Each well pumps to the same distance below lake level at any given time. Each well recovers within 3 ft. of the lake level within 10 minutes after pumping. That is why the shore of Lake Michigan was chosen, the water coming mostly from beneath the lake with a little from the other three sides.

Even though all the water must filter through 15 ft. of beach sand before it enters the screen, it is sent through the filtration plant and chlorinated slightly. This results in an extremely pure water, 36 per cent softer than the river supply, good tasting and cool. The citizens, summer residents and visitors are commenting very favorably every day upon the new supply.

The writer designed the installation, wrote the specifications, supervised the construction, was in charge of all correspondence with the contractor and testing laboratories, and although the water fund had a deficit of $41,000, devised a method of financing without resorting to a bond issue or borrowing and paid for the project in one year. The citizens of Grand Haven appreciated this, because they still owe $28,000 of a bond issue floated in 1912 for the point system and also owe $100,000 residue of a bond issue necessary for the filtration plant in 1926. The writer received no fee, his remuneration being the good-will of the people of Grand Haven and the $50 yearly salary paid to an alderman. H. Keith was in charge of the work for the Harmon-Ness Co. (now absorbed by the Layne Ohio Co.) and rendered valuable assistance to the writer during the progress of the work. The city chemist, N. T. Ellis, who has charge of the filtration plant, cooperated continually, especially during the change over from the river water to the new well supply, and has proven himself to be an able and efficient water analyst.

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The Trend Toward Monthly Publication of Engineering and Business Periodicals

During the past few months the following periodicals have changed from bi-weekly or semi-monthly to monthly publication:

Fire Engineering.

Pit and Quarry.

Power Plant Engineering.

Buildings and Building Management.

National Real Estate Journal.

The following have changed from weekly to monthly publication:

Power.

Textile World.

Manufacturers' Record.

The following have changed from weekly to bi-weekly publication:

Hardware Age.

Sales Management.

These ten periodicals are all members of the Associated Business Press. There are probably many more similar recent changes outside of the A. B. P. membership, for the depression has accelerated the general trend toward monthly publication.

Sixteen years ago the publishers of this magazine adopted the policy of monthly publication. At that time there were six construction and engineering weeklies of national circulation. Now there is only one such weekly.

Similarly, the national construction and engineering semi-monthlies and bi-weeklies have dwindled to one.

Five years ago one firm published the following 9 weeklies: Engineering and Mining Journal, Electric Railway Journal, Power, Aviation, Textile World, Coal Age, American Machinist, Electrical World, Engineering News-Record. Only the last two remain as weeklies. The first 6 have become monthlies, and the 7th a semi-monthly.

In "Standard Rate and Data," under Architecture, Building, Engineering and Contracting, Municipal and County, Roads and Streets, and Water Supply there are listed 117 periodicals of which 44 have a national circulation. Of the 44 only one, "Engineering News-Record," is published weekly, and but one is published bi-weekly, namely, "Water Works Engineering."

In general, the monthly type of periodical has become almost universal in the field of professional and business papers of national circulation.

SOME WATER WORKS LESSONS CHICAGO HAS LEARNED FROM THE DEPRESSION

By MYRON B. REYNOLDS
City Engineer, Chicago, Ill.

Myron B. Reynolds

THE many sad lessons of the present economic depression have not been entirely without advantages to those affected. In water works practice this has been especially true. As a group it is probably a fact that those serving and those served by this great public utility have suffered in a far lesser degree than a majority of other groups. The recognition of water works as one of the major self liquidating projects entitled to federal financial aid by the Reconstruction Finance Corporation has given emphatic recognition to our profession by the public and the investment bankers which has heretofore been of a mild character. Do we fully realize this and are we taking the best advantage of our possibilities? But the real question which all interested in water works must meet is "have we learned from our experiences of these last few years, and as a result are we better prepared to go forward?"

In Chicago domestic water consumption has held up as well as might be expected, although the number of active accounts has not increased in a normal way. It is a well known fact there has been considerable doubling up of families, but we are of the opinion that our population conditions are about normal and that the per capita consumption in the domestic class has held up. In the industrial classes there have been substantial declines in water consumption. This is very important as about two-thirds of the water revenue to the city comes from this class of service. A study of the reduction of industrial water consumption using representative industries of various classes as an index and their 1928 consumption as normal, shows the following percent of 1928 consumption in the respective years:

	Per Cent	
1928	100	
1929	96	
1930	86	
1931	79	
1932	71	(first six months)

Whether or not 1932 represents the low point is problematical, but if it does and the rate of return is the same as the decline we would not be back to normal rate until 1936. Based on studies of the length of time it took industry to recover from other economic depressions, 1938 to 1940 may be a more accurate estimate of our probable return to normal water consumption in this group of consumers.

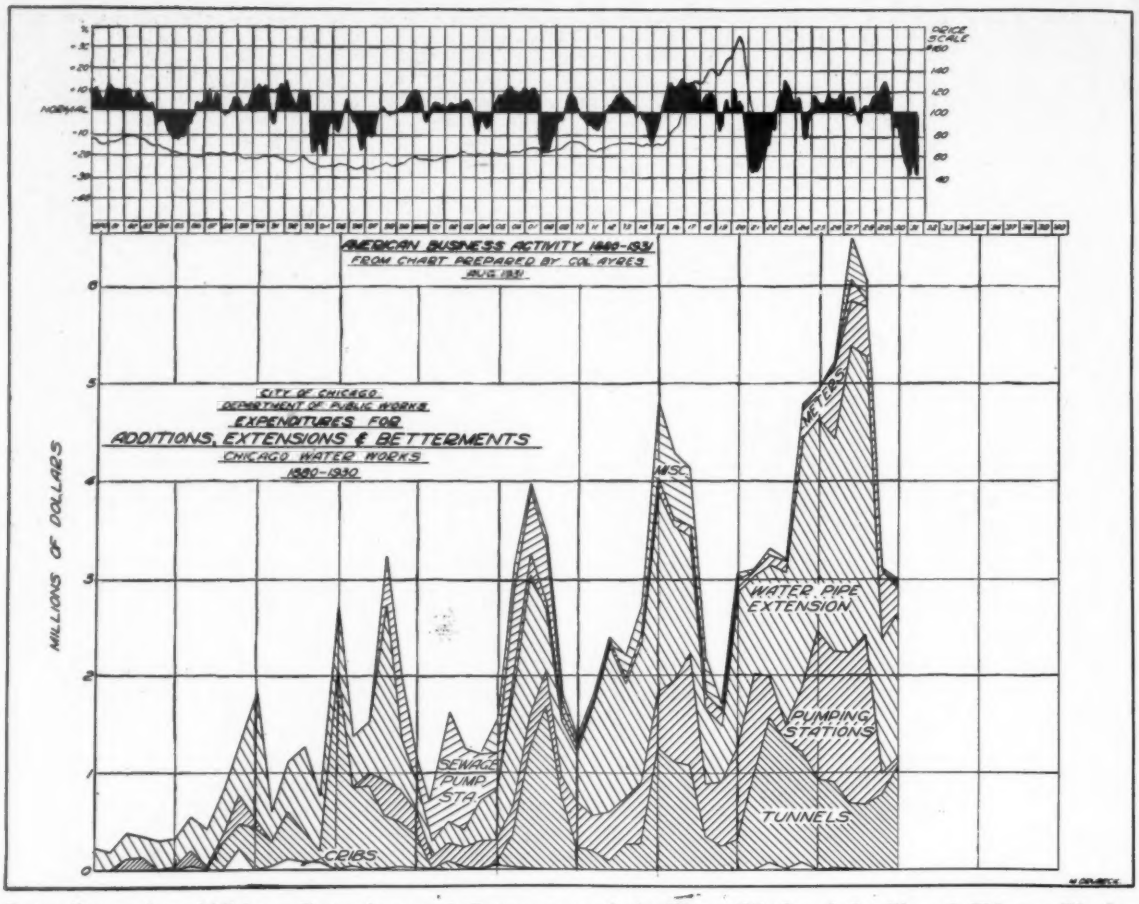
The effect of the economic depression has caused us in Chicago to make a more critical analysis of our water works development program and schedule of expenditures both in former years and for the future. Faced with possible limitations in revenue and bonding power in the next few years, we have been making very careful studies of what we could do with our present equipment, allowing a greater tolerance in customary operating standards. To our surprise our preliminary studies indicate that by modifying some of our preconceived ideas, and investigating more in detail in the economics associated with their application much can be accomplished. We have found that certain possibilities for changes of real significance have either been overlooked or had not been given the consideration which they merited, based both on engineering judgment and economic facts. For instance, there is a good probability that in Chicago, by increasing the velocity of flow in certain of our tunnels we can increase capacities without hazard to our structures, and then postpone new work which, based on our previous standards, we considered a necessity.

Faced with the need for economics at our pumping stations, our engineers have been making careful investigations of the economies of increased pumpage on water pressures in our distribution system. Some very interesting developments have resulted. It has been found that by modifying flow conditions in the distribution system to avoid friction losses, substantial operating economies can be effected without materially affecting service. This would allow the shutting down at night of pumps ordinarily operated, but apparently at a cost incommensurate with service rendered.

I have no doubt that at many filtration plants where the customary rated capacity of 2 gallons per square foot per minute has been the basis of operation and design, engineers have during this economic depression, and probably will for several years to come, allow for operation at higher rates, making use of chlorination and other means of water disinfection to compensate for possible decrease in the quality of the filtered water. While we should not entertain health risk to save a few dollars, it does appear that we might to advantage to all, more definitely locate the end point in our safety standards in these times when economies are essential.

Studies of our expenditures since 1880 have been prepared in the form of a graph, as shown. It illustrates clearly the cyclic characteristics of our expenditures. It also shows that the cost for each cycle of improvements was an increasing one. Much of our construction work was carried out at times when labor and materials were high. This really dictates to us the wisdom of a long-term program for future developments, with say a 5-year immediate work schedule, permitting fluctuations in the purchase of materials and employment of labor to meet favorable market conditions.

Of late we have been studying the probable effect of meterization in Chicago on future revenues. Some striking facts not heretofore considered have been uncovered. When we are on a metered basis unrecorded water consumption will mean heavy revenue losses. At present our metered consumption is mostly among large consumers. Some of the accounts are very substantial ones, running several hundred thousand dollars per year. Here the meter is a direct measure of revenue. In recent months we have been giving much more attention to checking accuracy of the meters than formerly. This has proven to be a very sound investment. It is



Expenditures for Additions, Extensions and Betterments of the Water Works of the City of Chicago, Ill., for the Period 1880-1930.

now clearly evident that in the future as our meterization program continues we shall have to give very strict supervision over the accuracy of meters.

Another point which concerns water revenues as a public utility enterprise is the effect of the size of the water bill on the promptness of payment. Most utilities bill their customers once a month and in general where discount is allowed payments are prompt. Assume for instance an average water bill for small consumers for a city in the vicinity of $15 a year. If billings are quarterly this bill will probably be larger than the average telephone, gas or electric bill for the month it is received. If billed semi-annually it is almost sure to be larger. I am wondering if it would not be good practice, especially in times when money is tight, to send water bills out once a month, so that the bill will be in the vicinity of $1.00 to $1.25., about equivalent to the monthly bill for the daily newspapers? It is of course assumed that mechanical equipment is used to permit low billing costs. These small bills are usually promptly paid, whereas the larger bills are those which are delayed. Furthermore, more people budget themselves on a monthly basis than on a quarterly or semi-annual schedule.

The average consumer appreciates the value of the water service and I believe it is good psychology to make this bill one of his smaller ones. It serves to show water service very favorably alongside of other utilities and should have considerable effect in creating good will toward the water department.

With few exceptions I believe water companies are not making the most of their contact with the customer to obtain his good will by emphasizing continually the low cost of water. At no time should this type of selling have the favorable effect as when money is tight. Therefore a period of depression really holds out a golden opportunity to water departments. The question is, do we all realize it, or are we just going along and complaining of our hard luck, and missing our opportunities?

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R. F. C. Funds for Water Works and Sewerage Improvements

A useful pamphlet showing how federal funds can be obtained for construction purposes from the Reconstruction Finance Corporation has been issued by the National Committee for Trade Recovery, 330 West 42d St., New York City. The information is of particular interest to cities which are in need of water works and sewerage improvements. In those states where legislation is needed before cities can avail themselves of R. F. C. funds for the above purposes, the model acts contained in the pamphlet offer valuable suggestions. These acts set up the machinery necessary to enable a municipality to borrow funds, when wanted for financing the construction of self-liquidating public works projects, and to repay over a period of years with funds derived from service charges, without involving municipal credit or increasing taxes.

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WATER SOFTENING IN THE UNITED STATES.—A booklet, "Rates, Revenues and Municipal Ownership of Water Works in the U. S., issued recently by the Burns & McDonnell Engineering Co., Kansas City, Mo., states that 134 municipalities in the United States have already provided necessary equipment to soften or partially soften their water supply.

FILTRATION PLANTS

A Section Dealing with Their Design, Construction and Operation

Conducted by JOHN R. BAYLIS, Associate Editor

Physical Chemist, Bureau of Engineering, Chicago, Ill.

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THE NEED OF A REFERENCE LABORATORY FOR TESTING ACTIVATED CARBON

DEVELOPMENTS in the use of activated carbon in water treatment indicate the need of a reference laboratory for testing carbon. The consumers should be assured when they purchase activated carbon that it will have the required adsorption, and the manufacturers of high grades of activated carbon should be protected from competition with inferior grades of material. A city recently advertised for bids on activated carbon, and received prices on 8 or 9 grades of carbon ranging in price from $55 to $118 per ton. With no knowledge of the effectiveness of the various materials it was impossible to let a contract intelligently, and the bids were rejected. When only one grade of carbon was being offered for water treatment the water works could purchase this material with the feeling that it was the best material available for the price, but with several companies now engaged in the manufacture of carbon the water works are at a loss to know what to do.

In the September issue of WATER WORKS AND SEWERAGE the writer gave what he thought would be suitable specifications for activated carbon. The specifications called for the material to be paid for on the basis of its phenol adsorption capacity. Phenol was selected not because it is a compound sometimes occurring in water supplies, but because it is a compound readily adsorbed by active carbon and is capable of being detected in extremely minute quantities. It is believed that some of the compounds which produce tastes and odors in water occur in the water in extremely minute quantities, and if this is the case it seems desirable to use some compound for testing the carbon which can be determined quantitatively in very small amounts. Perhaps as our knowledge of the characteristics of activated carbon increases it may be found that some compound more easily determined than phenol will give satisfactory indication of the suitability of the carbon for water works use. At the present time it is believed that the phenol test offers the best means of comparing carbons.

The phenol test, while not extremely difficult to make, requires care, and in the hands of the average laboratory technician accurate results might not be obtained. This is one of the main reasons why it is believed there is now real need for a reference laboratory on activated carbon. Even though another and more simple test may be developed, there may still be need for a reference laboratory. Carbon should be sold on the basis of its adsorption and it is esseneial that the tests be made accurately. It is possible to manufacture some of the chemicals used in water treatment with considerable uniformity in the product, such as aluminum sulfate, but such uniformity probably is not possible for activated carbon. Carbon may be produced which is high in the percentage of carbon in the material, though this does not give any indication of its adsorptive capacity. Highly active carbon manufactured from certain grades of lignite may have a carbon content of only 70 per cent, yet it may have an adsorption 50 to 100 times that of ordinary wood charcoal, which may be over 95 per cent carbon.

The primary carbon produced in the charring of carbonaceous materials is usually very low in adsorptive capacity. To make the material highly active it must be given additional treatment. Usually this is done by heating in a closed vessel to a very high temperature, and adding a certain amount of air or steam. It is not an easy matter for the best constructed plants to control the heat and the addition of air or steam so closely that the carbon will be activated exactly the same all the time. We should expect slight variations even with the best materials now on the market. When a crystalline product is being produced in the manufacturing process we can expect it to crystallize with considerable uniformity of composition, but the activation of carbon is entirely different. In fact, a material improperly treated in the production of the primary carbon may not be capable of being highly activated.

The various carbon manufacturers should not be expected to produce products which will have exactly the same adsorption capacity. Most of them could make their present commercial products more active, but the expense of higher activation might not be justified. What the manufacturer is trying to do is to produce a given adsorption at the lowest cost. It would not be profitable to increase the production cost 100 per cent to increase the adsorption capacity only 30 per cent. If specifications require the material to have a certain adsorption, and gave no bonus for a material of higher capacity it would not be fair to the manufacturers. At least it would not be fair to some of them, for their most economical product might be a material which has an adsorption 10, 20, or 30 per cent higher than the material called for in the specifications.

What the water works want is taste and odor removal, and they should expect to pay for the material on the basis of its power to remove objectionable substances from the water. In some instances there may be certain characteristics of the material which should be given

some weight in summing up the advantages of the material, such as fineness, the settling rate, or the rate at which it clogs the filter beds, yet in most instances these qualities are minor as compared to the adsorption. Specifications could be modified in such instances to give the proper value to these qualities.

The writer is of the opinion that it would be greatly to the interest of both the manufacturer and the water works to have a reference laboratory for testing carbon. Not much thought has been given to how such a laboratory should be established. A great deal of equipment is not needed for making the phenol adsorption test on carbon as given in the proposed specifications, and perhaps one of the present commercial laboratories would be glad to undertake such work. Both the manufacturer and the consumer should be satisfied that the person making the tests is capable of doing such work accurately.

Perhaps the matter of selecting a laboratory could best be handled by a committee composed of members of the American Chemical Society or the American Water Works Association and representatives of the carbon manufacturers. The manufacturers could act independently of the water works, though it is believed that cooperation between both the manufacturer and the water works would be best. Some of the water works might insist on the tests being made in their own laboratory, and that their test be regarded as final in determining the bonus or penalty to be paid even though no one in the laboratory is very skilled in making phenol tests.

This proposed joint committee could function also as a committee to study methods for testing and evaluating activated carbon, and could from time to time suggest changes in the specifications. It is very likely that the specifications proposed by the writer in the September issue will need changing when more information is available. Regardless of who sponsors the reference laboratory it should be run in a manner that will insure the tests being made properly.

Publicly owned water works purchasing materials in quantities which will cost more than $500 probably will be required to advertise for bids. The specifications can be made to define the required adsorption, and should provide a bonus or penalty for materials varying from the specified capacity. Any quantity of material in excess of a value of $500 justifies one test being made on the material. Assume that the cost of the test is $20, this is 4 per cent of $500, a very reasonable price to pay for assurance that the material is all right. If the purchase amounts to $1,000, the cost of one test would be only 2 per cent of the cost of the material. When a larger quantity is purchased the cost of the test will be less, though it may be desirable to make more than one test on each shipment in carload lots.

When material is purchased without specifications the manufacturer should be required to guarantee that his material will have a certain adsorption. If the purchaser desires, he may submit a sample of the material to the reference laboratory providing he pays for the test. If the material does not come up to the guarantee the purchaser is justified in rejecting the material or insisting on payment at a lesser price. It would be well for the purchaser to require the manufacturer to submit copies of previous tests made by the reference laboratory on the particular grade of material being offered. Knowing that the purchaser may have a test made of the material most any time, and that the reputation of the manufacturer depends upon meeting the guaranteed adsorption test, it is believed that all reputable manufacturers will welcome the opportunity of selling material in this manner. The manufacturers can then devote their efforts to producing high adsorption at the lowest cost and not to trying to convince some water works official or city council that their material at the price offered is better than some other material.

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Sewerage and Water Works to Cost Over $800,000,000 Needed

Needed sewerage and water works projects to cost $802,918,000 that are being held up because of the poor market for bonds are listed in a pamphlet issued recently by the National Committee for Trade Recovery, 330 West 42d St., New York City. The pamphlet tells how funds can be obtained from the Reconstruction Finance Corporation for financing construction of such projects for the relief of unemployment.

Sewerage Needed.—The following is the list showing the number and total costs of needed sewerage works that are being held up because of the poor market for bonds. These projects can be made self-liquidating and eligible for loans from the Reconstruction Finance Corporation.

State	Number of Projects	Total Cost of Projects
Alabama	2	$1,590,000
Arizona	2	1,354,000
Arkansas	6	624,050
†California	2	5,400,000
Colorado	1	30,000
†Connecticut	7	1,190,000
Georgia	4	14,820,000
†Illinois	50	63,095,000
‡Indiana	12	15,000,000
Louisiana	7	675,000
Maryland	4	900,000
†Massachusetts	22	7,385,000
Michigan	1	3,000,000
†Minnesota	1	15,000,000
Mississippi	1	30,800
Montana	4	105,000
New Hampshire	2	125,000
†New Jersey	3	18,617,500
New Mexico	1	62,500
†New York	15	51,062,000
†North Carolina	14	3,801,000
Ohio	16	13,937,000
Oklahoma	2	2,025,000
Oregon	1	750,000
Pennsylvania	2	16,000,000
†Rhode Island	3	2,050,000
South Dakota	1	190,000
Texas	24	9,785,000
Vermont	1	150,000
Virginia	1	2,500,000
Washington	1	2,050,000
†Wisconsin	1	1,250,000
Totals	*214	*$254,913,850

*Incomplete totals. *No reports received from 16 states.*

†States that are making preparations to pass legislation in January, 1933, that will enable their municipal governments to avail themselves of federal funds for financing self-liquidating public works.

‡Enabling acts passed at special session, September, 1932.

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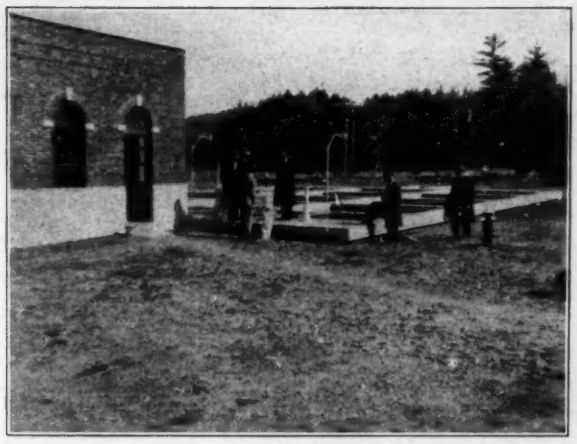
WATER REVENUE OF ST. LOUIS IN 1930 AND 1931.—According to the annual report of the Water Division of the city of St. Louis, Mo., for the year ending April 11, 1932, a total revenue of $4,225,051 was collected last year, while for the year covered by the report the total revenue was $3,904,760. This is a decrease in revenue of $320,291 or 7.58 per cent for the fiscal year ended April 11 last. This decrease in revenue was due to manufacturing and business in general being below normal and to vacancies occurring in residential property.



Saranac Lake's New Sewage Treatment Plant (Settling Tanks and Pump Station.)

FALL MEETING NEW YORK STATE SEWAGE WORKS ASSOCIATION

THE New York State Sewage Works Association held its Fall meeting at Saranac Lake, N. Y., on Oct. 14 and 15, with ideal weather and the mountain aflame with color of autumn foliage.

The forenoon of the first day of the meeting was taken up with a visit to points of interest in nearby Lake Placid of winter sports fame. Before returning to luncheon at Saranac Lake, and the official opening of the meeting the recently rebuilt sewage treatment plant at Lake Placid was inspected.

A novel feature of the Saranac Lake meeting was the "Sunrise Breakfast" at which the "Question Box" was conducted by Morris Cohn and C. C. Agar in an entertaining and enlightening manner. Being voted a distinct success, the Question Box Breakfast will be a regular feature of future meetings of the Association.

The location of the meeting place in the heart of New York's beautiful mountain and lake country was probably the reason for the large number of ladies in attendance.

The Hon. Seaver A. Miller, mayor of Saranac Lake, who said that they were pleased with their new sewage treatment plant, addressed the association at the opening luncheon and again at the dinner given by the City of Saranac Lake.

Important Resolution Drawn

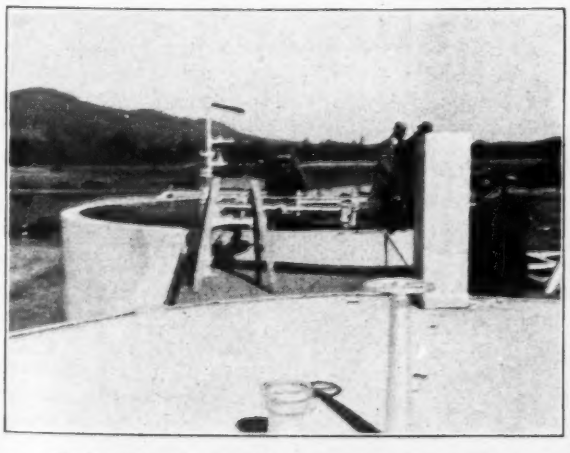
Secretary-Treasurer Bedell reported that the association had taken in 36 new members since the Spring meeting—now having a total membership of 289 and a surplus of $420 in bank.

The Committee on Resolutions drew the following important resolution which was accepted and endorsed by the members of the association:

"In the interests of economy, municipalities in New York State have reduced or are contemplating the reduction of operating and maintenance funds at sewage treatment plants.

"The New York State Sewage Works Association recognizes the need for economy in municipal government and favors all possible economies in sewage treatment, but considers any serious reduction in operating and maintenance funds as a menace to public health, to the water consumers of the State, to the sanitary progress of the State and to the physical condition of the existing treatment plants.

"Be It Therefore Resolved, That the New York State Sewage Works Association protests against any drastic or unproportionate reduction in operating and maintenance funds for sewage treatment by municipalities."



Sludge Digestion Tanks, Saranac Lake, N. Y.

Technical Sessions

Professor Earle B. Phelps, Presiding.

The first paper was that by Mr. Henry W. Taylor, Consulting Engineer of New York City, who had designed and supervised construction of the new sewage treatment plant at Saranac Lake and likewise had drawn plans and specifications and supervised the rebuilding of the plant at Lake Placid. Mr. Taylor's paper dealt with a description of the Saranac Lake plant and operating data during the first nine months. The plant is of the separate sludge digestion type, being equipped with Jeffry mechanical sludge and scum removal mechanisms. Circular digestion tanks provide 40 days' sludge digestion capacity and open sludge beds 1 square foot of area per capita. One digester is equipped with a Downes' floating cover and is heated; the other has a fixed cover and was designed for sludge storage and secondary digestion. Much of the trunk sewer leading to the plant is of cast-iron pipe supported above ground on concrete piers. Automatic pump stations in the system deliver crude sewage to the plant and are so equipped that the pumps automatically reverse at the end of each pumping period and thereby are self-cleaning.

A novel feature of the settling tank design is the arrangement of sludge hoppers. At the inlet end of the tanks primary hoppers receive the coarser and most rapidly settling solids without aid of scraping mechanism. The secondary hoppers just beyond receive lighter solids carried further through the tank and those which the sludge scrapers drag to them. Thus the loading on the Jeffry scraper mechanism is reduced by 50 per cent and disturbance of the deposited solids is reduced to a minimum when the mechanism is operated. But one complete revolu-

tion of the scrapers followed by sludge pumping to the digesters is practiced every 24 hours. Sludge deposition studies, said Mr. Taylor, had shown that such practice would keep the tank bottom clean and at least 33 per cent of the total sludge deposited had dropped out in the first 7 feet of tank length and that 57 per cent of the total was being deposited in the zone between 7 feet and 50 feet from the inlet of the tanks.

Mr. Taylor said that the Saranac Lake plant designed for 15,000 was serving 11,000 people at present (1.58 m.g.d. average sewage flow) to give an average velocity in the settling tanks of about 4 feet per minute and a retention period of 2.9 hours. Sludge removed had amounted to 55 cu. ft. per day per capita—a figure considerably in excess of that reported in the literature for domestic sewages. Considerable difficulty had been experienced with sludge and scum which had been slow to digest. When digestion had gotten started severe foaming had been experienced even at pH 7.4. Since May the average gas produced had been 4,000 cu. ft. per day, which figured roughly 0.35 cu. ft. per capita per day.

Uniform temperature and pH values in the digester and other advantages had been secured by recirculating the sludge-liquor by way of pumping and jetting it downward under the gas dome on the digester cover. More recently the digesters had been operated to provide two stage digestion—scum which had been slow to digest being drawn daily from the primary heated digester to the secondary unheated unit. Fresh solids are pumped to the primary digester (14,000 cu. ft. capacity) twice daily.

In reply to questions asked, Mr. Taylor said that one man operates the plant and makes the necessary tests for pH values of digestion tank contents, takes temperature readings and makes settling and stability tests. Unfortunately, supernatant liquor could be drawn only from the primary digester and that was allowed to settle in the pump-well before delivery to the crude sewage. In his experience he had found sludge bed areas of 1 cu. ft. per capita to be about 40 per cent in excess of actual requirements when separate sludge digestion was practiced.

C. C. Agar of the State Department of Health, said that unfortunately funds had not been available to equip a laboratory at the plant. During the past year, however, 18 laboratories had been equipped and put in service at various sewage treatment plants in the State.

W. Donaldson of New York City said that it was surprisingly inexpensive to set up a laboratory for small treatment plants and $150 to $200 would pay for everything needed in the way of equipment.

President Phelps complimented the author on his use of a combination of experimentation and design practice which had made it possible to predict certain phases of plant performance and then design accordingly.

"Studies of Sewage Disposal Involving Bathing Beach and Shellfish Pollution," by Earle B. Phelps, of Columbia University, and Ellis K. Phelps, Pardee Engineering Co., New York City.

The junior author in presenting the paper said that the investigation had for its object the determination of the geographical extent and intensity of sewage pollution from specified sources over a tidal area in which shellfish interests and bathing beaches were involved and in which pollution from other sources had also been present. By adopting the device of recording the time of sampling the waters in lunar hours (time after high tide), the results of bacterial examination, at 8 selected stations made daily over a 6-week period could be averaged by two-hour periods to give a picture of the influence of tidal circulation. In this picture the individual effect of pollution from the various sources could be detected. The interpretation of the data was clarified by float studies of the tidal currents. During a second period of six weeks, similar examinations had been made while the sewage plant effluents from the specified sources were being chlorinated. A third period was followed through under conditions like those in the first period, as a seasonal control.

F. A. Cary, Superintendent Sewage Works, Fairport, N. Y., and R. N. Clark of Innis, Speiden Co., New York.

J. L. Barron, of Westchester County Department of Health, and Wellington Donaldson of Fuller & McClintock, Engineers.

George Mowbray, Superintendent Sewage Works, Port Chester, N. Y., and C. C. Agar, of State Department of Health.

A study of the changes between period one and period two had produced quantitative values in addition to the qualitative data obtained by the tidal variations. The actual intensity of pollution from the specified sources and its relative value with respect to pollution from all sources were thus determined for each of the eight stations over the basin.

In reply to questions Professor Phelps said that he believed that shellfish should be grown in clean waters regardless of any degree of assurance that chlorination of the sewage would eliminate danger of disease propagation and he felt that the same argu-

ment applied also to bathing areas. More extended treatment than chlorination was to his mind required and believed it practicable to reclaim much of the now condemned shore line areas. He said that 12 days after commencing chlorination of the settled sewage there had been a 99 per cent improvement in the water at the outlet of the large harbor as measured by the presumptive B. coli test.

C. A. Holmquist, Director of the Bureau of Sanitation, State Department of Health, reported that chlorination of settled sewage at the Port Chester,

W. G. Bahl of Jeffry Manufacturing Co., and Mr. Cottrell of Innis-Speiden Co.

N. Y., plant had been recently started. The practice adopted had been prechlorination with sufficient dosage to insure a residual in the settling compartments of the Imhoff tanks.

Discussion by others as to the relative value of the lime chlorine process as compared to ordinary chlorination followed. The chief advantages from the use of the lime-chlorine combination to produce hypochlorite being the greater economy and sustained action of the chloramines produced. Observations had indicated sustained residual chlorine several miles down stream from a plant discharging settled sewage which had received the lime-chlorine treatment. In conjunction with prechlorination it had proved particularly advantageous.

"Maintenance and Operation of the Sewer System and Treatment Works of the Long Beach, N. Y., Sewer District," by George Nesbitt, Superintendent of Sewers, Atlantic Beach, N. Y.

Mr. Nesbitt described the sewerage system of Long Beach, N. Y., and sewage treatment by sedimentation in plain settling tanks (4 hours' detention) and effluent chlorination. During June to October the population served had been 5,000. Two long outfalls into the ocean had been lost as the result of storms or had become clogged with sand. He did not believe long outfall lines to be practical in the open ocean.

The chlorine demand of the settling tank effluent had varied considerably and had risen to 25 parts per million before changes were made to prevent crude sewage remaining for long periods in three pump wells before delivery to the plant. The installation of Wallace and Tiernan vacuum semi-automatic chlorinators had also resulted in a saving of chlorine. The use of lime applied at the pumping stations might have contributed to a reduced chlorine requirement. Employing effluent chlorination he had found it necessary to change the rate of chlorine feed frequently during the day if an excess of residual chlorine was to be maintained without a waste of that chemical. The sewage effluent and bathing beach waters had been examined daily for bacteria and B. coli content. The chlorine dosage had averaged 8.5 p.p.m. to maintain 0.5 p.p.m. residual in the effluent.

To pay operating and maintenance costs of the sewerage system a sewer-rent, based upon number of outlets, is charged in addition to a tax based upon area of property served that tax being 26 cents per 100 square feet where the property is served and 15.5 cents per 100 square feet on property not served.

Concerning the value of keeping pump sumps in a cleanly condition, reduce to chlorine demand and conserve chlorine, **L. H. Enslow** said that he could not say enough. In the Long Beach case the added lime had probably been to some extent responsible for the reduced chlorine demand but the systematic cleansing of pump sumps and more frequent pumpings has been to the major extent responsible.

The Question Box

Discussing sewage problems at the breakfast table is something new in program arrangements, but met with considerable success.

As Morris Cohn aptly stated, "What Dorothy Dix is to lovers seeking advice and information, the Question Box is to the sewage treatment plant operator and superintendent."

Some of the more important questions dealt with brought forth the following opinions:

Glass covered sludge beds may be expected to yield between 50 and 60 lbs. of dry solids per square foot per year whereas open beds will take care of 30 to 35 lbs. per square foot per year.

Lime can be effectively added to digestion tanks *only* when sludge or supernatant liquor is recircu-

Left to Right: W. R. Schreiner, Chemist, Westchester County Sewerage Commission; Glen D. Holmes, Consulting Engineer, Syracuse, N. Y.; Fred K. Wing, Consulting Engineer, Buffalo, N. Y.

lated and the lime is applied to the pumped material. The lime may be fed dry or as an emulsion.

Power companies have a legal right to give preferred rates to municipalities that are not shown in their regular schedules. With current at 3 cents per k.w.h., operation of small pumping stations with electric power will be more economical than use of Diesel engines unless the latter should be operated at full load with not less than 300 h.p. required for the job at hand.

In chlorinating for odor control, the presence of

residual chlorine would in most instances not be required. In cases where neighbors were very close to the sewer or the sewage treatment plant, residual chlorine in the sewage might be required during the late afternoon and early evening because of the habits of odor travel during those periods.

Nitrites in oxidized sewage will produce a *slow* color development with orthotolidin. The color is brownish rather than greenish yellow. Use of starch and potassium iodide, with boric acid added instead of acetic acid, will give no color if nitrites are present

Henry W. Taylor, Consulting Engineer, New York City.

F. E. Finch, Sales Manager, The Hardinge Co., York, Pa.

but a positive blue will be produced if residual chlorine is present.

The moisture content of digested sludge has less bearing on rapidity of draining on sand beds than the quality and gas content of sludges. All things being equal, their sludge drains more rapidly than thick sludge.

Skimmings from settling tanks had been collected in flour barrels half filled with sawdust and when the sawdust became grease logged the barrel, sawdust and skimmings had been consigned to the incinerator. Skimmings had also been dewatered on sand beds or delivered with sludge to the digestion tanks—the last being perhaps the most practical and least troublesome scheme of the three.

The disposal of sludge from final (secondary) settling tanks had been solved without odor nuisance by adding 75 lbs. of chlorinated lime to the final tank before pumping out the sludge to the sand drying beds. The sludge drained better and dried more rapidly than previously and without odor nuisance formerly experienced.

Round Table Discussions

(A. F. Dappert, Vice-President, Presiding.)

After a recess of ten minutes following the Breakfast Question Box Session, the members returned to the oblong breakfast table to listen to Round Table discussions of operating problems and their solution.

"Winter Operation of Sewage Treatment Plants."

Arnold Hale, Superintendent of Sewage Treatment at Brighton, N. Y., reviewed his experiences with freezing troubles at their two sprinkling filter plants. Riser pipes to nozzles had frozen only when the nozzles had become clogged and this trouble had been corrected by drilling downward through mush ice to start a small sewage flow which would melt out the ice.

Morris Cohn had made use of large nails to drive holes through the ice in the risers at Schenectady.

F. J. Biele and **F. W. Wing,** Consulting Engineers, said that small holes drilled in the side wall of risers had been effectively used by them to drain the risers after the dosing cycle had been completed. Mr. Wing had several plants so equipped.

Henry W. Taylor, Consulting Engineer, said that gas lines from digesters would not freeze if of ample diameter. He thought 2-inch pipe should be about the minimum size used. Scum, between the lip of floating covers on digesters and the concrete wall, had frozen and given trouble. They had pumped the warm sludge liquor to the top of the cover for thawing out the scum. If the liquor could be super heated that would be more effective. It was essential to keep the cover free moving and frozen scum was a problem in severe climates.

"Conditioning of Sludge in Separate Digestion Tanks."

F. A. Cary, Superintendent Sewage Works, Fairport, N. Y., reported considerable difficulty with acid sludge caused by apple products plant wastes dumped into the sewers. Lime, soda ash and ammonia had all been tried to correct the acid condition without appreciable success. The apple refuse had eventually to be excluded from the system and the digester emptied and started again. Thereafter systematic lime additions during daily sludge recirculation using a Marlow Mud Hog pump had been very effective in sludge conditioning and improving digestion. He felt indebted to the State Health Department personnel for the help that had been given him in straightening out their difficulties.

H. W. Eustance, City Engineer, Ithaca, N. Y., reported that after many vicissitudes the "volcanic" digester at Ithaca had been brought into line as a well behaving unit—he hoped once and for all time. Their experiences at Ithaca had been all that one might ever expect from a digester that had decided to be a scum digester instead of a sludge digester. Well planned operations had gone for naught and experience had been a thorough if not expensive teacher.

Liming had been scientifically done by transfer of sludge and scum to old septic tanks and return to the digester. The barrel test in which lime added to 50 gallons of sludge is sufficient dosage to raise the pH to 7.0 gave a figure which had been used in dosing the entire tank. Something has slipped in the calculations. The result was a dense sludge too alkaline to digest and consequently its eventual consignment to the city dump. Starting fresh again with a warm digester and daily lime application to the crude (fresh) solids pumped in, the pH of the digester contents was maintained at 6.6 to 6.8, but not without difficulty. Then with 6 feet of "coming" sludge in the digester one day, the very next day it was at the top and coming over board. What to do next? Someone suggested resting the digester. They did for 10 days and started again with more foaming resulting. Another rest of two weeks and a new start with sludge liming and recirculation. Finally the problem had been licked—no scum, no volcanic action. The pH value remains at 7.0, the sludge dries well without odor and contains 7 per cent solids. Visitors are now welcome at Ithaca.

A. J. Fisher, Engineer, The Dorr Company, New York, said that according to his experience new tanks will always have to pass through a period of so-

called "foaming" regardless of what may be done. Lime added to recirculation sludge when carefully done was helpful in the early stages of digestion. His advice was to let the tanks foam and after that the troubles would be over. Foaming was caused by delayed digestion and thereafter a sudden onset. This natural phenomena could not be prevented when starting new tanks receiving fresh solids only.

"Chemical Treatment of Sludges to Facilitate Drying" was dealt with in a very thoroughly prepared paper read by C. C. Agar, Assistant Engineer of the New York State Department of Health.

Mr. Agar reviewed briefly the history of the application of chemicals in sewage treatment. He said that chemical precipitation processes seemed to offer greater promise than heretofore considered. Especially would that be true when dealing with sewages charged with industrial wastes deleterious to biological processes. The precipitation process might serve alone or in combination with the latter.

H. W. Eustance, City Engineer, Ithaca, N. Y.

Recently, coagulating chemicals had been employed as effective aids in sludge dewatering—the subject of his assignment. For such use ferric chloride appeared to be the most efficient coagulant. Mr. Agar referred to the use of alum at Tenafly, N. J., to increase the capacity of the glass covered drying beds receiving activated sludge—the dosage being about 18 lbs. of alum to each 1,000 gallons of sludge. At Plainfield, N. J., Downes had used alum for some time in conditioning digested sludge—7 lbs. to each 1,000 gallons of sludge being the dosage employed. The result had been to increase the capacity of the open drying beds at Plainfield about 33 per cent. At other points 3 lbs. of ferric chloride per 1,000 gallons of sludge had been highly beneficial in speeding the early stages of dewatering very markedly. In using chemicals a quick mix and immediate application of the conditioned sludge to the beds had proved an important phase of the process. The liberated carbon dioxide gas was effective in floating the sludge, thus allowing the water to drain out rapidly.

Sludge conditioning to preclude odor nuisance during drying was also an important item and for improving dewatering and control of odors chlorinated lime had proved highly efficacious at several New York plants. At Huntington, L. I., 20 to 30 lbs. of chlorinated lime are added to each 1,000 gallons of sludge during bed fillings and at Port Chester 2 lbs. per 1,000 gallons had been helpful. At Greenwich, Conn., the chlorinated lime had been applied to the sand surface at a rate of 50 lbs. per 1,000 sq. ft. just prior to sludge drawing. At Fairport, N. Y., chlorinated lime is effective in speeding dewatering of secondary tank sludge and for controlling odors.

Mr. Agar in conclusion felt that for poorly digested sludges (low in pH value) lime and chlorinated lime were most effective as dewatering aids, whereas ferric chloride, chlorinated copperas or alum were to be preferred with better digested or fresh sludges.

R. N. Clark, Engineer, Innis-Speiden Company, New York, reported that the correct dosage of ferric chloride for sludge conditioning would lie usually between 5 and 8 lbs. (actual $FeCl_3$ content) to every 100 lbs. of dry solids content of the sludge to be treated. In connection with poorly digested sludge 10 to 12 lbs. of ferric chloride per 1,000 gallons of sludge seemed to be requisite. Demonstrations of sludge conditioning and speed of dewatering were later made by Mr. Clark during the inspection of the sewage treatment plant at Saranac Lake.

E. D. Flynn, of the Oliver United Filters, Inc., New York, reported on sludge dewatering experiences at Baltimore, Md. Digested sludges had required 5 lbs. of ferric chloride and 15 lbs. of lime to each 100 lbs. of dry solids when dewatering on Oliver type vacuum filters. At Chicago a combination of crude sludge and activated sludge had required no lime and 3 to 4 lbs. of ferric chloride per 1,000 lbs. of dry solids.

Following the adjournment of the meeting the members inspected the Saranac Lake sewage treatment plant—the operation of which was explained by Henry W. Taylor, who had designed the plant and supervised its operation.

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Association Meetings Scheduled

Nov. 14-15—**Virginia Water and Sewage Works Association.** 4th Annual Meeting, Stonewall Jackson Hotel, Staunton, Virginia. Secretary, H. W. Snidow, 601 State Office Building, Richmond, Va.

Nov. 28-Dec. 2—**American Association of Pools and Beaches.** New York City. L. L. Jenne, Executive Secretary, 725 Bulletin Bldg., Philadelphia, Pa.

Dec. 5-9—**Tennessee Water Works Short School.** University Tenn., Nashville, Tenn. P. J. Morton, Director, % State Dep't Health, Nashville, Tenn.

Jan. 16-18, 1933—**American Society Municipal Engineers.** Annual Convention, Detroit, Mich. Executive Director, C. W. S. Sammelman, 4359 Lindell Blvd., St. Louis, Mo.

Jan. 16-19, 1933—**Texas Water Works Short School.** Temple, Texas. V. M. Ehlers, Secretary, % State Dep't Health, Austin, Texas.

Jan. 17, 1933—**New York State Sewage Works Association.** Hotel McAlpin, New York City. A. S. Bedell, Secretary, % State Dep't of Health, Albany, N. Y.

Feb. 9-11, 1933—**Kentucky, Tennessee Section American Water Works Association.** Brown Hotel, Louisville, Ky. F. C. Dugan, Secretary-Treasureer, 532 West Main Street, Louisville, Ky.

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Dollar and Cents Value of Water Softening

The following interesting note is taken from the report of Aug. V. Graf, Chief Chemical Engineer, Water Purification Plants, as given in the annual report of the Water Commissioners of St. Louis, Mo., for the year ending April 11, 1932:

"The value of softening water supplied to cities has recently been clearly demonstrated by a survey made by H. W. Hudson of the University of Illinois College of Commerce. By determining the amount of soap sold in towns being supplied with waters of varying hardnesses, he was able to show the great saving resulting from softening. The saving in soap effected by the average reduction in hardness of 77 parts per million, based on a price of 10 ct. per pound for soap, amounts to $1.54 for every thousand gallons of water used for washing purposes; allowing one gallon per capita per day as the average quantity completely softened for washing purposes, the total saving per day would be $1,265.88 or $463,312.08 for the year based on a population of 822,000 inhabitants. This saving in soap alone is greater than the entire purification cost."

THE ELECTRON-SHELL THEORY OF WEATHER CYCLES

By HALBERT P. GILLETTE

AS POINTED out in the March, 1932, issue of WATER WORKS AND SEWERAGE, the earth evidently has an electron-shell whose poles gyrate around the axis of the earth in 7 years, thus causing both a 7-year and a 10.5-month weather cycle. In "Engineering and Contracting," of the same date, I showed that there is also a 14-month weather cycle having peaks coincident with those of the 10.5-month cycle every 7 years. Evidently, then, there are two electron shells whose poles gyrate around the axis of the earth in 7 years, the one gyrating clockwise and the other anti-clockwise. In the case of clockwise gyration equation (1) gives the length of the subcycle (10.5-months in the case under consideration), for it gives the period of time between successive pointings of the north pole of the shell most directly toward the sun, which would effect the greatest magnetic displacement of the shell. Equation (2) gives the corresponding length of a subcycle of the shell whose poles are gyrating anti-clockwise.

$$(1)\quad m = NP/(1+N)$$
$$(2)\quad M = NP/(1-N)$$

N = period of a complete gyration of the shell in years (7 years in this case).

P = orbital period of the planet (12 months in this case).

m = subcycle of weather due to clockwise gyration of the poles of one shell (10.5 months in this case).

M = subcycle of weather due to anti-clockwise gyration of the poles of the other shell of the pair (14 months in this case).

By means of cyclogram analyses (Balfour Stewart's method), I have found evidence that the earth has several pairs of oppositely gyrating electron-shells. For N = 2 years, M = 24 months and m = 8 months. The one is the long known 2-year cycle, and the other is the 8-month cycle recently discovered by Abbot.

Many weather cycle researchers have commented upon reversals of phase in weather cycles. Others, notably Bruckner, have called attention to oppositions of phase in different regions. While I have not yet confirmed beyond doubt the following theory, it fits so many facts that it is probably correct.

If, in addition to the slow gyratory rotation of the poles of an electron-shell, there is a much slower pendulistic swing of the axis of the shell around the earth's axis, then not only will there result simultaneous opposition of magnetic effect in different regions but inversions of effect in any given region. In the case of the 2-year main cycle both simultaneous opposition of phase in different regions occur, and periodic inversions of phase in one region. By means of sequoia tell-rings, I have been able to find that this inversion of phase of the 2-year cycle occurs every 36 years. The 2-year cycle in the thickness of clay-varves of ancient glacial lakes in New England is very pronounced and leads to a similar conclusion.

This theory leads to the inference that during the period of transition from one phase to a reversed phase, the 2-year cycle will disappear completely; and this is the case.

It also leads to the inference that a 36-year cycle exists. This inference has been verified.

Several facts have hitherto indicated that the earth is encased by several electron-shells. Cloud layers, widely separated in vertical elevation, indicate different electron-shells; for electrons are known to condense moisture upon themselves. Stoermer's radio echoes having different intervals of time between the signal and its "echo," point to the same conclusion. Finally, only a few months ago two radio engineers found that the Kennelley Heaviside layer is two layers, the lower surface of one being 62 miles above the earth, while that of the other is 125 miles high. Note that the latter has double the height of the former, and refer to my article in WATER WORKS AND SEWERAGE, October, 1930, where it was pointed out that a cloud layer is about twice as high above the earth as the one below it. This same geometrical progression series in which the ratio is 2, is to be seen not only in the distances of planets from the parent sun but in the distances of moons from the parent planet. The inference is that a series of electron-shells encases every rotating heavenly body, and that just as our lower electron-shells attract moisture (often forming clouds) so the outer electron-shells attract matter ejected from a planet or a sun, and thus aid in building up other heavenly bodies.

The earth's axis gyrates like that of a spinning top when the top wobbles. As Newton discovered, gravitative forces account for this gyration and its period which is nearly 26,000 years. Similarly magnetic forces should cause gyration of the axis of any electron-shell; and many meteorological phenomena can be explained if such gyration is assumed to occur.

The earth's crustal uplifts show evidence of molten whirl-belts that were probably rotated magnetically. (See "Engineering and Contracting," February, 1932.) Apparently such molten cyclones are still somewhat active, for earthquake cycles correspond with weather cycles as to length and phase. In several instances permanent air cyclones exist near molten cyclones, judging the latter by the circular arcs of crustal uplift; e.g. the arc of the Aleutian Islands and the Alaskan Peninsula in the vicinity of the "permanent Aleutian cyclone." Both the rotation of the molten matter and of the air are evidently due to currents of electrons that cause magnetic rotation when in a magnetic field. When the North pole of one of the two electron-shells that cause the 7-year weather cycle is nearest the axis of one of these permanent cyclones (e.g. that of the Aleutian Islands or that of Iceland), the magnetic effect is intensified, and the cyclonic whirl of the air becomes more violent. A cyclonic whirl spirals upward, its electrons carrying moisture into upper and cooler regions, thus tending to cause rain. In a great permanent cyclone there form minor cyclones and the latter tend to migrate away from the parent whirl. Thus we receive the storms that sweep southeastward from the region of the Aleutian "low." The major features of weather cycles are electrodynamic phenomena, in which heat convection plays but a minor role.

MEETING OF THE CALIFORNIA SEWAGE WORKS ASSOCIATION

Reported by J. H. RIDER, C. E.

THIRTY-NINE cars, containing the members and guests of the California Sewage Works Association, gathered in front of the City Hall at Oceanside, Calif., on the morning of Sept. 26, 1932, for the purpose of visiting four of the smaller southern California sewage treatment plants en route to the meeting at San Diego, Calif. The first stop was at the Oceanside septic tank and ocean outfall where R. L. Loucks briefly described the plant. New tank covers with gas vents had been constructed at a cost of $5,000 after the original structure had been injured by an explosion. C. A. Bower, Superintendent of the Carlsbad Sanitary District, gave the construction details of the Carlsbad plant which was the next visited.

The units of the Vista Sanitary District, housed by stucco buildings of Spanish architecture, consist of an Imhoff tank, weir box, dosing chamber, trickling filter, humus tank and pump house, and sludge drying beds. The Escondido plant with a contributing population of 2,500 is also attractively landscaped. Alva Smith, Consulting Engineer of Los Angeles, explained the units of this plant, which consist of a pump house containing a wet well for sewage and a dry well for two pumps which run intermittently; a screening and distribution chamber; two settling tanks, a mixing and preaeration chamber; four diffused air aerating units with spiral flow; a final settling tank with Hardinge clarifier; a chlorinating and measuring basin; a reaeration tank and sludge digestor. R. F. Goudey gave an interesting laboratory demonstration of bulking and "debulking" activated sludge at this plant. A quarter of a dried apricot, a tomato, a ripe fig, and an onion were added to as many different cylinders of sludge and the contents of each cylinder were aerated for an equal length of time to illustrate the fact that vegetable and fruit pulp will cause sludge to settle poorly. Lime or fine sand were used to "debulk" the sludge in these cylinders indicating that debulking is a physical rather than a chemical or biological phenomena. According to Mr. Goudey's theory it was a matter of increasing the gravity of the sludge which caused the settling after it had been bulked.

A Ford coupe of the Los Angeles County Sanitation District with full laboratory equipment was exhibited by A. P. Banta and F. D. Bowlus, who gave a demonstration of collecting a sample of sewage and running tests for temperature, pH, chlorine demand, and sulphides—the whole operation requiring but three minutes.

A stop was made at noon for an informal luncheon, which the Escondido committee had arranged.

The Meeting

The first regular session of the 5th Annual Convention of the Association was opened by President W. A. Allen on the afternoon of Sept. 26 at the U. S. Grant Hotel, San Diego. The San Diego State Teachers' College plant was described by D. B. Phelps. The plant consists of a settling unit, sprinkling filters, slow sand filters, separate sludge digestion. Chlorine is applied at three points: raw sewage entering settling tank, dosing chamber, and final effluent. The final effluent is stored in 40,000 gallon tank and used to irrigate the campus.

Sewage Analysis and What They Tell the Operator was the subject of a very comprehensive paper presented by **E. A. Reinke** of the California State Dept. of Health. Mr. Reinke described properties and composition of sewages and discussed standard methods for analysis with an interpretation of results. **T. R. Hazeltine** spoke of the advantage of having records and operating data available when planning future plant enlargements; for research; to determine adequacy of treatment and to facilitate routine plant control. He thought that analytical data had its chief value when translated into plant design. **R. F. Goudey** stated that the vision tests by the operator should be corroborated by laboratory tests. He commented on the lack of standardized methods; the nitrogen trio, the bugbear of the analyst; the effect of filamentous organisms on nitrates; and suggested the necessity of having both chemical and biological control in plant operation. He said that indications were that the total number of bacteria in activated sludge should be kept below 500,000 bacteria per c.c. **Dario Travaini** gave a resume of the laboratory work done at the Phoenix, Ariz., plant and **Jane H. Rider** outlined minimum tests necessary at small plants.

Sewage Purification by Chemical Processes at Palo Alto was described by **Ralph A. Stevenson** of the Great Western Electrochemical Co. An experimental plant at Palo Alto treats 36,000 g.p.d. using 250 lbs. chlorine and 200 lbs. Ferric chloride per million gallons. The process is divided into three stages, it being possible to regenerate the iron floc formed, making it practical to use it over and over for 50 cycles. Sludge collected in the primary tank is not so treated, the iron being recovered from the secondary precipitation stage. **H. O. Banks,** Sanitary Engineer, said that the advantage of chemical methods was found in lower costs, neglible power consumption, small area of land required, freedom from odors, reduced volume of sludge, simplicity of design and operation. Sludge containing moderate quantities of iron seemed to digest better than otherwise. **Dr. Paul J. Beard** of Stamford University thought it worth while to call this experiment to the attention of members and spoke of difficulties in transferring a study from the laboratory to the field. It promises to produce a high grade treatment for the cost of low grade treatment, and may furnish a new possibility in the reclamation of water.

A paper covering **Unusual Conditions Encountered in California Sewer Design and Construction,** prepared by **Charles H. Lee,** was read by **W. M. Frickstad.** Mr. Lee offered four reasons for standardized procedures in designing and installing sanitary sewers, storm water sewers, and combined sewers. He thought there was a controlling size of sewer beyond which it is cheaper to allow overflow and pay damages. **A. M. Rawn,** in discussing this paper, said that Los Angeles County Sanitation District does not build storm sewers. In the sanitary sewers the slow velocity, warm sewage, and mineral sulphate content gave rise to hydrogen sulphide production which

made it advisable to employ vitrified liners for the crown of sewers and the walls above line of flow. **C. C. Kennedy** said possibly they used combined sewers in the San Francisco Bay District because the City of San Francisco started the habit, but that the precipitous grades formed a more justifiable reason.

Business Meeting

The Award of Merit presented annually to the plant showing the most outstanding improvement or achievement during the year will be continued. After hearing the report of the Legislative Committee and the discussion, the Association adopted a policy of devoting the major part of their efforts to advocating and promoting constructive legislation looking to the betterment of sewerage and sewage works operation in California.

J. Jacobson of Davis, Calif., was elected president, D. C. McMillan, City Engineer of Ventura, first vice-president, and T. R. Haseltine, Supt. Sewage Treatment Plant, Salinas, second vice-president. E. A. Rienke continues as secretary-treasurer. W. A. Allen and A. M. Rawn were elected representatives to the Board of Control of the Federation of Sewage Works Association.

The members joined the League of California Municipalities at a luncheon. The mayor of San Digo and other city officials spoke.

Operating Experiences

Operating Experiences at the Phoenix, Ariz., Plant by Dario Travaini. Built to relieve stream pollution and prevent odor nuisances, the Phoenix plant is of the activated sludge type with separate sludge digestion. Mr. Travaini said that local and climatic conditons have caused some operating difficulties which are being corrected by minor changes in the plant and in the daily routine. **Jane H. Rider,** Sanitary Engineer of the State Department of Health of Arizona, discussed this paper with reference to the effect of sewage treatment at Phoenix upon certain State problems, saying that the condition of Salt river had been materially improved and odors reduced.

The Control of Anaerobic Decomposition During Sewage Transportation, by A. P. Banta and F. D. Bowlus, was an interesting and well illustrated paper. The authors discussed the effect of temperature on sewage decomposition and the resulting increased sulphide content and chlorine demand. Chlorine had been applied at carefully selected points along the Los Angeles County Sewer System to keep sewage fresh while en route to the plant. The cost had been approximately $6.00 per million gallons, but its application had tripled the capacity of the treatment plant. Systematic cleansing of the lines reduces sulphide production and thereby saves chlorine.

Water Contamination from Toilet Flush Valves, by Walter Putnam. It was brought out by Mr. Putnam and also by Dr. Carl Wilson as discussors, that when B. coli is continuously absent from 50 c.c. portions of a water supply as it enters the mains, the B. coli found in the system are not due to after-growths but must be charged to a definite pollution in the system. This has been established by use of dyes. In Pasadena nearly every type of toilet flush valve was tested and none were found entirely positive in action. Positive safety would only result when installing a tank on the roof and separate piping to fixtures.

John W. Ledoux

JOHN W. LEDOUX, well known hydraulic engineer of Swathmore and Philadelphia, Pa., died on November 7th as the result of injuries received in an automobile accident the night previous. Mr. Ledoux was in his 72nd year, having been an eminently successful engineer up to the time of his death. He was born at St. Croix Falls, Wis., graduated from Lehigh University in 1887 and in 1890 became chief engineer of the American Pipe and Construction Company, a position he held for thirty years. For the past twelve years he had been consulting engineer for numerous municipalities and private water companies. In 1920 Mr. Ledoux was retained to make a survey of the Philadelphia water supply system and to make recommendations for securing additional water supply. During his association with the American Pipe and Construction Company Mr. Ledoux designed more than one hundred water systems and treatment plants in America and foreign countries and perfected many devices for increasing the efficiency of such plants. For the invention of an improved water meter he reecived the Edward Longstreth Medal from the Franklin Institute in 1919. One of the most important projects developed by Mr. Ledoux was the water supply system of the Pennsylvania Railroad, between Pittsburgh, Philadelphia, Washington and New York. He was vice president of the Simplex Valve and Meter Company, a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Water Works Association and a number of other professional associations.

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Morris Knowles

MORRIS KNOWLES, a prominent sanitary and hydraulic engineer, died of heart attack on Nov. 8, at his home in Pittsburgh, Pa., after a short illness. He was 63 years old.

Mr. Knowles went to Pittsburgh in 1897 as resident engineer of the Filtration Commission and from 1901 to 1910 served as chief engineer of the Pittsburgh Filtration Works. From 1909 to 1915 he was a leading member of the Pittsburgh Flood Commission. He had been a member of the Lawrence (Mass.) Water Board, the Pittsburgh Civic Commission, the boards of the advisory engineers in the Miami (Ohio) Conservancy District, the Chicago Sanitary District and the Zoning Committee of the United States Department of Commerce. He also had belonged to the Civic Development Group of the United States Chamber of Commerce.

During the World War (1917) Mr. Knowles was supervising engineer in the construction of Camp Meade and Camp McClellan and in 1918 served as chief engineer of the housing division of the U. S. Shipping Board. From 1911 to 1920 he was director of the Department of Sanitary Engineering at the University of Pittsburgh.

Specializing in water works and filtration systems, Mr. Knowles built up an international reputation, having served many municipalities, private water companies and industries. He was a prominent member of the American Society of Civil Engineers, the American Water Works Association, and the New England Water Works Association, and other technical associations, having served as a director of the first named.

At the time of his death he was president of Morris Knowles, Inc., Consulting Engineers.

EDITORIALS

WE FAVOR:

1. No diversion of water works revenues.
2. Laws permitting a city to issue "revenue bonds" for water works or sewerage improvements.
3. The passage of a "sewer rental law" in every State similar to that in Michigan.
4. Universal metering.
5. Universal treatment of water to secure not merely elimination of harmful bacteria, but freedom from hardness, odors and bad tastes.
6. Cessation of stream and lake pollution.
7. The pension system for municipal employees.
8. Licensing of consulting engineers and of operators of water and sewage treatment plants.
9. Periodic employment of consulting engineers to diagnose any economic troubles and prescribe the cures.
10. Elimination of "politics" from the construction and operation of water works and sewer systems.

The Depression and Water Works Income

WHY municipalities have found it necessary to cut salaries of the essential operating staffs of water works systems, other than to satisfy the popular demand of the public, is difficult to understand. In times of prosperity the lawyer, baker and candle-stick maker have little concern as to the meager salaries paid municipal employees who, if delivering a similar service to private enterprise, could demand a materially higher salary than that paid to municipal employees responsible for delivering a safe and wholesome supply of water to the residence of Mr. Citizen.

Anyone who has observed a child grab something from a weaker playmate in order to compensate for loss of something taken from him by a stronger playmate in the group, can understand the psychology behind salary reduction of municipal employees at the first bite of income reduction which is felt by Mr. Citizen even though he may still have an income considerably in excess of that of the manager of the local water works.

In times of prosperity the same citizen that will tell the efficient servant of the public what a fool he is to work for the municipality for such inadequate salary, will look with envy at the maintained income of this same servant in times of depression. Thinking selfishly of himself and not considering the past, during which the municipal employee's salary has not been advanced in keeping with advanced costs of living, in a depression he will loudly clamor that everybody else's income had been reduced and therefore municipal salaries should be given a blanket cut and taxes reduced.

Admitting that some municipal activities might, without great detriment, be temporarily suspended and certain jobs abolished during periods of depression, and acknowledging the wisdom of temporarily reducing personnel where it could be done without crippling a department or without allowing plants and equipment to become run down at the heel, it is difficult to justify the reductions in salaries of water works personnel in responsible positions that have been put into effect during the recent depression.

The costs of materials and equipment required in operating and maintaining water works systems have dropped appreciably, the gross income derived from the sale of water has dropped on the average less than 10 per cent in this country and the net income even less. A survey recently completed by the Committee on Statistics of the North Carolina Section of the American Water Works Association and reported on at the meeting recently held at Winston Salem, N. C.; by W. H. Booker as Chairman, revealed that during the past three years of depression water works extensions and new services had, as might be expected, dropped off materially. On the other hand, water consumption and income *collected* had decreased surprisingly little. An average of 85 gallons consumed per capita had dropped to but 72 gallons during the past three years.

Regardless of the surprisingly meager drop in receipts and reduced operating costs, every North Carolina municipality had reduced salaries of its water works employees. A twenty per cent blanket reduction had been put through in practically every instance and in some cases even more of a reduction had been enforced —this in addition to an accompanying reduction in personnel in most cases.

To the North Carolina committee, it seemed that injustice had been committed in reducing salaries of employees responsible for operating a utility which produced income for the municipality to the extent that had been practiced; nor did it seem fair to cut salaries in the water department to the same extent as should apply to other departments which were in no wise self supporting, much less income producing. The committee presented the statistical report in hopes that it might prove useful in combating the practice of any further blanket salary cuts of water department employees by municipalities and possibly to assist in the reduction in some measure of the unreasonable cuts already suffered by many water works men.

It is with the same objective in mind that the publishers of WATER WORKS AND SEWERAGE take this opportunity to call attention to the injustice done to far too many loyal, hard working, conscientious water-works employees, responsible for the safeguarding of health and protection of property of the public they serve.

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R. F. C. Aid vs. Securing Loans From State Relief Funds

APPLICATION for R. F. C. aid in financing water works and sewerage improvements and new projects have not been conspicuous by their number. This probably has been due to the apparently tedious and difficult procedure through which applying municipalities must go in order to secure R. F. C. funds. Satisfying bankers as to the adequacy of security behind the loan and methods to be adopted in securing income to amortize the loan seemed to some municipalities to be of easier attainment in securing loans than attempting to unravel the red-tape of the R. F. C. requirements. Such a case is represented in the attitude of the city authorities of New Bedford, Mass., as evidenced by the statement of

Stephen H. Taylor, Supperintendent of Water Works of New Bedword, made before the recent meeting of the New England Water Works Association when discussing R. F. C. aid. Mr. Taylor said in effect, that after due consideration they had concluded that it would be far simpler and less time consuming to secure loans from local banking interests than to proceed with application for R. F. C. funds.

The R. F. C. relief program has seemingly not taken the course which it was assumed it would and instead of helping municipalities unable to secure banking assistance, the activities of the R. F. C. simmered down, in substance, to a hard boiled investment operation, the corporation taking the position of guarding appropriated funds until the borrower could prove in effect that R. F. C. assistance was in fact really not needed.

It is encouraging to note that recently there has been some leniency on the part of the R. F. C. in interpretation of requirements of the relief act in the matter of refusing aid to projects wherein any part of the financing of which is to be accomplished with the use of funds derived from income secured through taxation. Funds derived from front-foot assessments against benefited properties have been ruled, in general, as income for service rendered and therefore are no longer considered in the true sense a tax. In addition it is now allowable to utilize tax income for payment of already existing obligations, thus rendering present and future income from the project in question acceptable as a source of funds for paying interest on and for amortization of loans applied for. Thus the R. F. C. is endeavoring to meet the requirements under which it must function by law and at the same time render the procuring of loans for public works less arduous.

With the greater leniency in interpretation of the letter of the law on the part of the R. F. C. and the assistance being rendered municipalities without charge by competent engineers, the job of unraveling the red tape is being reduced to a minimum and procuring of loans is made much simpler and easier for the small as well as the large municipality.

Attention is again directed to another channel through which financial aid for unemployment relief and construction of water works or sewerage projects may be obtained. In an editorial in WATER WORKS AND SEWERAGE for July it was disclosed how Lancaster, N. Y., had procured money from the State Relief Fund for revamping its sewers and sewage treatment works and thereby provided, at one time, local employment and sewerage improvements. In a second editorial in the August issue it was suggested that municipalities not able to meet R. F. C. requirements—particularly in connection with sewerage betterments or new projects—should consider the availability of the $300,000,000 fund allotted the R. F. C. for relief loans to the several States. In securing money from this fund it would be borrowed from the State at the favorable rate of interest which is paid the National Government for its allotment of distress relief appropriation. States have not made full use of their ability to secure such relief funds and it appears likely that the simplest, least costly and least time-consuming procedure for small towns to follow is to apply to the Governor or Comptroller of their respective states for a loan from this fund.

L. H. Enslow

"Eighty-three Tax-Free Towns"

In a very instructive water works booklet recently published by Burns & McDonnell Engineering Co., there is given a list of "eighty-three tax-free towns." The meaning of "tax-free" is this: These towns pay for their local government with revenues from water works or other municipally owned utilities; but they still pay State, Federal and school taxes. The largest town in the list is Lubbock, Tex., with a population of 20,520. Tweny-one of the 83 have populations under 1,000; and only 13 have populations over 5,000.

The expense of local government is usually so slight in towns of less than 5,000 people that it can be paid by an increase in water rates that is not burdensome. Yet we believe it to be an unwise practice to use any public utility as a tax collector. It is particularly objectionable where the town is growing rapidly as well as where its water works system is not ideal in every respect. Where no diversion of water works revenues occur, and where water rates are adequate, extensions and improvements can either be paid for out of earnings or can be used to pay bond interest and amortization of bonds issued to pay for additions and betterments.

It is becoming rapidly clearer that in many cities water rates should be sufficiently high not only to support a water works plant but the sewer plant. The water rates then become a charge not only for delivering the water but for carrying it away. This combined water and sewer rate would never be very high, and since bills would be paid monthly, the burden would be so light that very few citizens would oppose adequate extensions and improvement of the municipal hydraulic system.

Most of our towns are polluting streams, lakes or ocean beaches with sewage; and will long continue this unsanitary practice unless the cost of sewage treatment is made as light as to be unobjectionable. By a relatively slight increase in the water rates, it will be feasible usually to do away with this pollution.

If municipal and consulting engineers will undertake to educate the public, not many years will pass before an economic and sanitary ideal will be attained.

▼

"Revenue Bond Laws" Are Needed in Many States

Only 23 States have revenue bond laws under which a municipality can build or buy a water works or sewer system and retire the bonds from revenues derived therefrom. Every one of the 48 States should have such a law, and it should be so drawn that service charges for the use of the sewerage system may be imposed.

Water works and sewerage associations are the logical ones to have such laws drafted and presented to State legislatures.

It should be permissible, but not mandatory, to make these revenue bonds an obligation upon the entire city. The reason that it should not be mandatory to do so is this: A city cannot legally exceed a certain limit of bonded indebtedness, except in those cases where the bonds are an obligation only upon a utility plant.

Engineers should be leaders in securing the enactment of laws that will aid in the rapid improvement of water works and sewerage systems. Never was the need of such leadership more imperative than now.

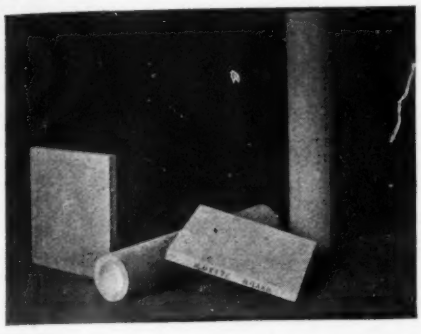
H. P. Gillette

NEW EQUIPMENT AND MATERIALS

Aloxite Brand Air Diffusers for Sewage or Water Aeration

The Carborundum Company of Niagara Falls, N. Y., have just recently issued an engineering bulletin describing air diffuser plates and tubes made of fused crystalline alumina.

In this publication the qualities and characteristics of Aloxite Brand diffuser plates and tubes are discussed and illustrated by graphic charts and photographs. One graph shows the pressure losses at varying rates of air diffusion when plates of several different permeabilities are employed. It is claimed that Aloxite Brand diffusers will furnish the smallest size bubbles, combined with the lowest pressure loss for any given capacity of any product on the market.



Aloxite Brand Diffuser Plates and Tubes

Aloxite Brand plates or tubes can be obtained with permeability ratings ranging from 4.0 cu. ft. per minute to 60.0 cu. ft. per minute (dry test under 2-in. water pressure). Standard size plates are 12x12x 1-in. and standard tubes are 24-in. long with a 3-in. internal diameter and 5/8-in. wall thickness.

The Carborundum Company maintains a permanent research laboratory and a technical and sanitary engineering staff which are at the service of consulting engineers, city engineers or others interested in aeration problems, particularly the activated sludge process of sewage treatment and water aeration, mixing, etc.

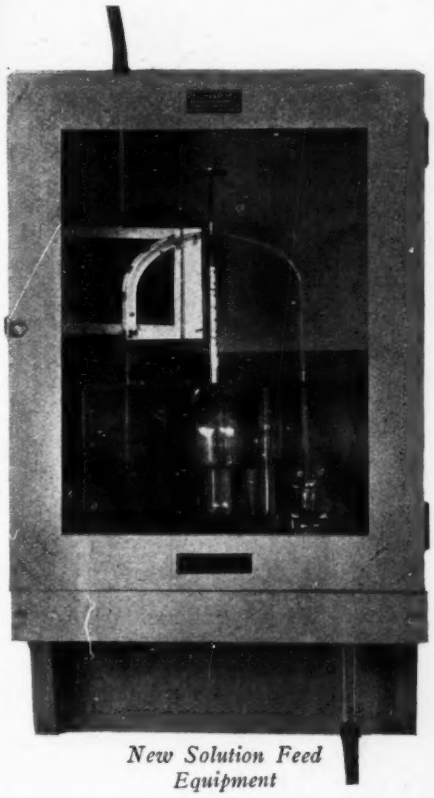
This Engineering Bulletin (No. 1) is worth writing for. Address The Carborundum Company, Niagara Falls, N. Y., attention Sanitary and Filtration Department.

Note.—In October WATER WORKS AND SEWERAGE a description of air diffusers produced by the Carborundum Company erroneously stated that these were made of carborundum. The manufacturers have called our attention to this error and we are pleased to print the above corrected description of this new type of diffuser, which is made of highly resistant oxide of alumina.—Editor.

Novel Solution Feed Equipment

Phipps & Bird, Inc., of Richmond, Virginia, offer a new device for feeding solutions at a constant rate. The features of this feeder are simplicity, ability to resist corrosion, constancy of feed and complete accessibility of all parts for cleaning or replacement.

The heart of the feeding device is a siphon mounted on a parallel motion hinge, the free end of which is carried on a float operating in the rectangular tank from which the solution is fed. The solution flows from the main supply tanks to the rectangular feeding tank under the control of a float valve, which throttles the inflow of solution to the rate at which the siphon is feeding. The rate of feed depends on the difference in level between the solution in the tank and the outlet end of the siphon. A convenient screw is provided to alter this difference and thereby alter the rate of feed for adjustment to the desired flow. This adjustment is maintained because the siphon is carried on a float and any change in level is compensated for by a corresponding change in the position of the float and siphon assembly.



New Solution Feed Equipment

The output of the siphon is caught in a glass vessel formed to serve as both a funnel and a trap. When the supply to the feeder is stopped, this trap seals the open end of the siphon and causes the siphon to be kept primed in readiness to commence feeding as soon as the supply to the apparatus is restored.

All parts of the apparatus can be dismantled for cleaning with no other tool than a screw driver.

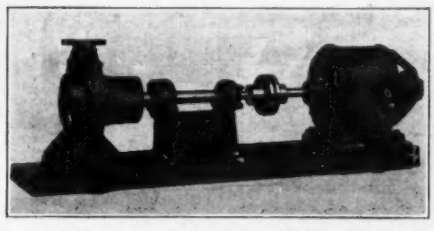
There are two pieces of accessory apparatus that have been designed to work in conjunction with the feeder where required. One is an automatic valve for switching the feed from one solution supply tank to another when the first runs dry. This will be of great advantage where it is desired to maintain feeding over extended periods and where it is inconvenient to continually watch the supply tank. The valve is not necessary where feeding is intermittent or where conducted under supervision. The other accessory is a pressure filter which can be used to remove suspended matter from the solution to be fed if that be desirable.

The ability of this apparatus to feed any material in solution regardless of its corrosiveness makes it extremely interesting to those who are concerned in the treatment of water and sewage. Its low price and simplicity should make it valuable to those responsible for the treatment of small water supplies and swimming pools. Industrial and experimental laboratories also should find it a major aid in carrying out their work.

The feeder is available for immediate shipment from Phipps & Bird, Inc., 140 Virginia Street, Richmond, Virginia, who will gladly furnish additional information on request.

Pumps for Ferric Chloride, Etc.

One of the difficult problems in pumping corrosive acids has been in obtaining pumps that would give satisfactory and efficient service over a sufficient period of time to justify their cost. For many acids it has been impossible to obtain pumps of high efficiency which would last more than a few months, although many metals and substances have been tried. For pumping liquids, such as hydrochloric acid, on which metals cannot be made to last, a rubber lined pump has been added to the line of the Quimby Pump Co., Inc., 340 Thomas St., Newark, N. J. These pumps are rubber lined by the "Vulcalock" method as processed by the B. F. Goodrich Rubber Co. They are actually high efficiency centrifugal pumps having the entire inside of the casing and stuffing



Quimby Doty Rubber-Lined Pump

box lined, and the impeller covered with pure, live, soft rubber. Every part of the pump which is in contact with corrosive fluid is completely covered and protected against corrosion. The special acidseal rubber used is claimed to be ideally adapted to handling corrosive solutions.

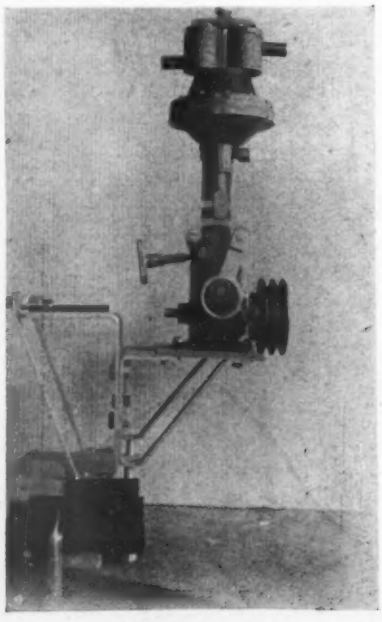
Automatic Proportioning of Ferric Chloride to Sludge

The Chicago Sanitary District in its experimental West Side Sewage Treatment Plant selected ferric chloride treatment of filter sludge as the best means of concentrating the solids for continuous filtering.

Proportioneers Co., 7701 Anthony Ave., Chicago, Ill., were retained to design and build the special ferric chloride feeder, and have added the "tret-o-motor of special ferric chloride type," known as Ferr-O-Feeder, to their line of proportioning devices. It is driven by texrope and pulleys connecting it to the variable speed shaft driving the Dorrco sludge pump. Thus it is kept in step with rate of flow changes of sludge. A gear reducer slows down the device from line shaft r.p.m. to practical pumping speed. The reducer unit drives an eccentric and connecting rod which flexes a rubber diaphragm pump a number of times per minute in proportion to sludge throughout.

Diaphragm, casing, special check valves, reagent piping, in fact every part of the device which is in contact with the corrosive reagent is of rubber, hard or soft. Check valves are made for instant inspection, removal and cleaning.

The diaphragm is 6-in. diameter, feeding from 2 G.P.M., down to practically zero. Its adjustment lies in the arrangement for shortening its stroke, which is accomplished by simply turning a stroke adjusting screw of minute accuracy which fixes the position of a link motion controlling the stroke length. A scale is located on the micrometer adjusting screw for indicating the stroke length or reagent delivery. While the machine automatically compensates for sludge flow changes the operator can even during high speed operation cause minute adjustments in the ferric chloride feed to maintain constant pH reading.

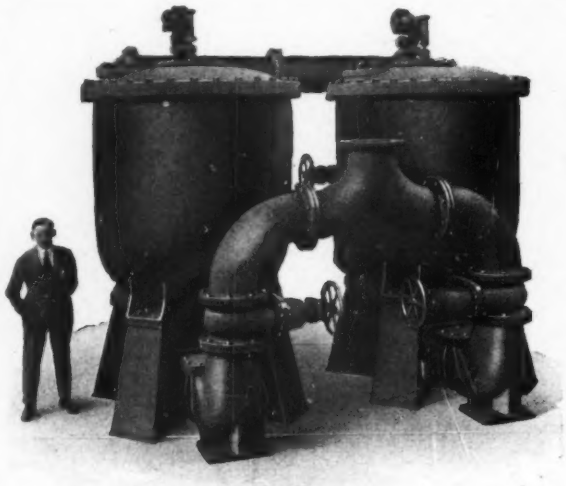


Ferric Chloride Feeder

WITH THE MANUFACTURERS

Long Service Record of Shone Sewage Ejectors

In 1891 three 250 Gallon Shone Duplex Pneumatic Sewage Ejectors were installed in vaults under street intersections to handle sanitary sewage from a low level section in Rogers Park where gravity drainage could not be obtained with the main sewers then in use. The ejectors were operated through underground air lines from a duplex compressor installation in the old Rogers Park Water Works on the Lake Front.



Shone Ejectors

For over forty years these ejectors have operated night and day without interruption and with only nominal maintenance and repair charges, and they were only shut down a month or two ago on completion of a new sewer which made the further operation of the ejector system unnecessary.

New Meter and Pump Bulletins

New Bulletins listed below have been recently issued by the Worthington Pump and Machinery Company, Harrison, N. J.:

Gas Engines—6-page bulletin S-550-S4 describing horizontal 4-cycle double-acting 30-inch stroke engines. Includes cross section views and specifications.

Water Meters—8-page bulletin W-900-B-12 describing improved cold water disc meters. Includes illustrations of all available sizes and chart showing comparative loss of head.

Centrifugal Pumps—arranged for automatic priming—4-page bulletin W-323-B1 describing construction and application of new line of pumps equipped with "Hytor" priming unit.

Drainage and Irrigation Pumps—vertical rotating shaft type—4-page bulletin D-450-S12.

Deep Well Pumps—vertical rotating shaft type—4 page bulletin D-450-S9 covering wells up to 6 inches; 4-page bulletin D-450-S10 covering 6-inch, 8-inch and 10-inch wells; 4-page bulletin D-450-S11 covering 12-inch, 14-inch, 16-inch and 20-inch wells.

Statement of the Ownership, Management, Circulation, Etc., Required by the Act of Congress of August 24, 1912,

of Water Works and Sewerage, published monthly at Chicago, Ill., for Oct. 1, 1932.

State of Illinois, County of Cook, ss.—Before me, a notary public in and for the state and county aforesaid, personally appeared E. S. Gillette, who, having been duly sworn according to law, deposes and says that he is the business manager of Water Works and Sewerage and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor and business manager, are:

Publisher—Gillette Publishing Company, 400 W. Madison St., Chicago, Ill.

Editor—H. P. Gillette, 400 W. Madison St., Chicago, Ill.

Managing Editor—C. T. Murray, 400 W. Madison St., Chicago, Ill.

Business Manager—E. S. Gillette, 400 W. Madison St., Chicago, Ill.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) — Gillette Publishing Co., 400 W. Madison St., Chicago, Ill.; H. P. Gillette, 400 W. Madison St., Chicago, Ill.; Mrs. R. W. Hume, 303 S. Stone Ave., La Grange, Ill.; E. S. Gillette, 400 W. Madison St., Chicago, Ill.; Winifred Gillette, 1125 Oak Grove Ave., San Marino, Calif.; Provident Trust Company, Chestnut and 12th Sts., Philadelphia, Pa.; Louise Forsythe, 12 E. Windemere Terrace, Lansdowne, Pa.; La Verne Louer Hellyer, Ambassador Hotel, Chicago, Ill.

3. That the known bondholders, mortgagees and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages or other securities are: (If there are none, so state.)—None.

4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association or corporation has any interest, direct or indirect, in the said stock, bonds or other securities than as so stated by him.

E. S. GILLETTE,
Business Manager.

Sworn to and subscribed before me this 28th day of September, 1932.

(Seal) KITTIE C. WOULFE,
Notary Public.

(My commission expires Feb. 8, 1934.)

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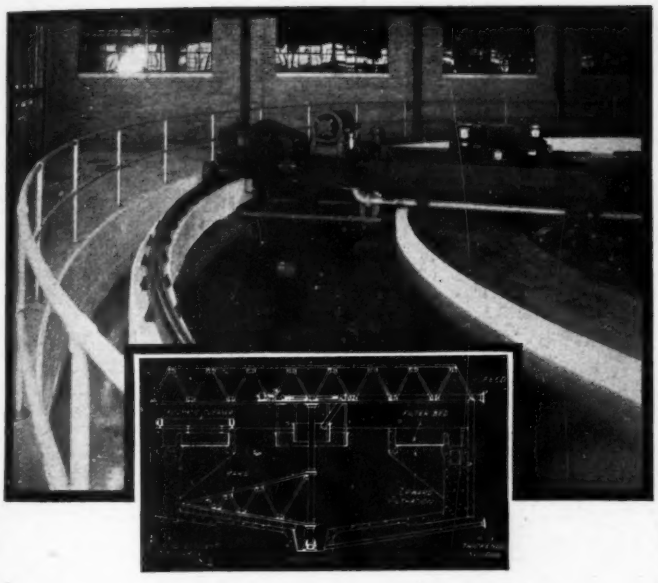
For the Better Removal of Suspended Solids from Sewage and Industrial Wastes



—Permits of usual sedimentation and thickening operations within a tank, at high capacity for a given tank size.

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—Filter bed embraces entire circumference of tank, extending inwardly five feet or more.

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FERRIC CHLORIDE, $FeCl_3$, Content 60%, the well-known lump or crystal, is a solid at ordinary temperatures.

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ISCO 66% FERRIC CHLORIDE SOLUTION is the answer to many coagulation problems in addition to sewage sludge dewatering.

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EDWARD S. HOPKINS
Principal Sanitary Chemist, Bureau of Water Supply, Baltimore, Md.

THIS is a handbook for which there has been genuine need in the water-works field for a number of years. Its audience is the plant operator. It is particularly designed to meet his needs. It is a book of simple discussion and simple directions. It aims to present the practical, usable facts in systematic form.

ABEL WOLMAN SAYS: "The number of texts of a purely operating character is decidedly limited. Those that are good are somewhat out of date, and therefore, this volume fills a current need.

"No matter how well designed a water treatment plant may be, its product is dependent to a great degree upon the efficiency of the man operating it. To improve and guide the operator is the primary function of this book. It is designed, in simplicity of language and arrangement, to meet the needs of the rank and file. It should lighten the load on many control agencies and should stimulate the already conscientious operator, whose task is so well done and so rarely given public recognition, to higher levels of performance. The book should be on each operator's desk."

—Excerpts from the Foreword

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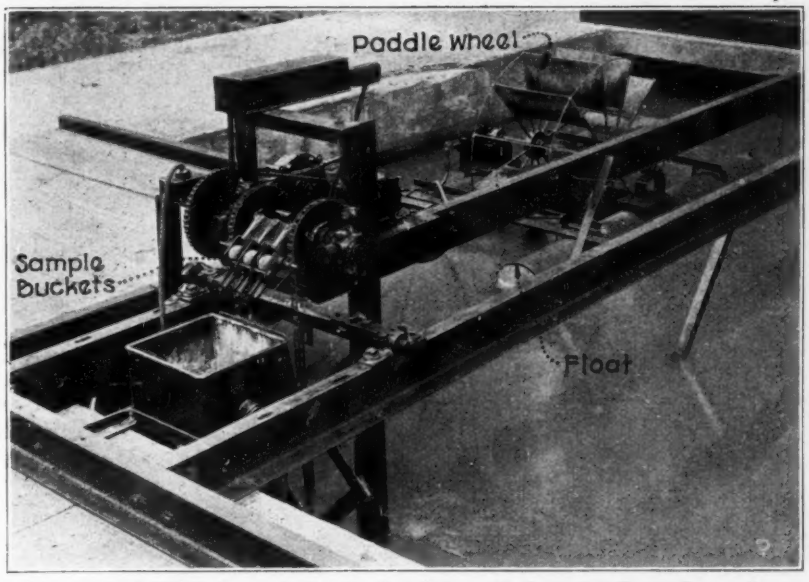
This machine is also readily adaptable to many industrial sampling problems such as diluted stock, white water in paper mills, manufacturing wastes, or process liquids.

If you are interested in obtaining truly representative samples of crude or treated sewage—at low cost—write for complete details.



Photograph of GECO Automatic Sampler Installation with Protecting Covers Removed

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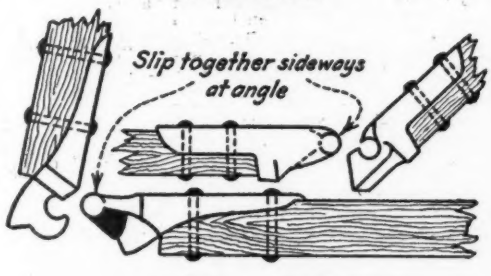

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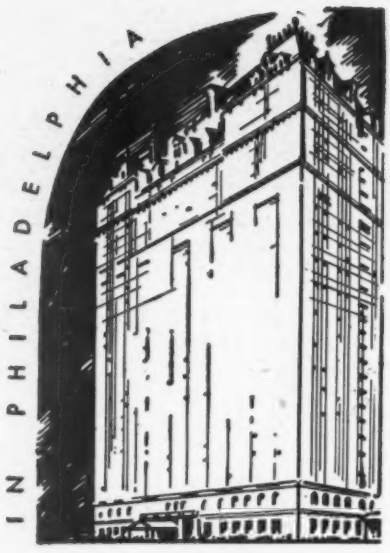

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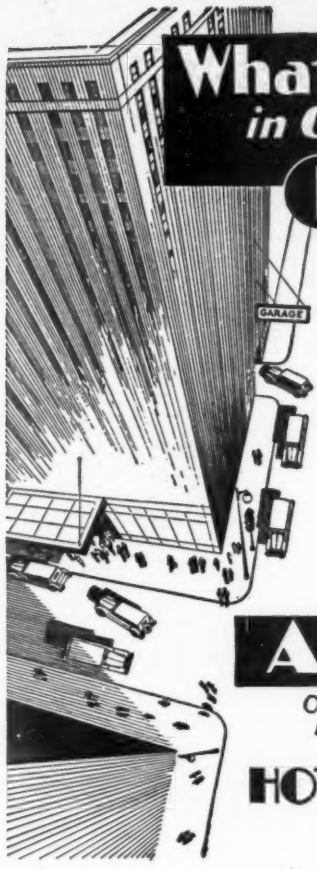

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WATER WORKS SUPERINTENDENT—22 years' experience in operation and management of water works. Seventeen years as superintendent in metropolitan area of 50,000 population, in charge of three separate water works systems. Experienced in managing water softening and deep well supplies, including location and drilling. Salary secondary consideration. Age 46. Address "F. E. S.," % Water Works and Sewerage, 420 Lexington Ave., New York City.

ENGINEER-SUPERINTENDENT—B. S. in Sanitary Engineering. 13 years experience in operation of large and small sewage treatment works and experimental sewage treatment, activated sludge, Imhoff tanks, sprinkling filters, pressing, filtering and heat drying of sludge. Married. Age 34. Address "R. S. S.," Water Works and Sewerage, 400 W. Madison St., Chicago, Ill.

CIVIL ENGINEER—Age 23; B. S. in Engineering, Princeton University, 1929; C. E., Princeton, 1932, with thesis in Water Supply. Over two years with American Bridge Company, Engineering Department, but very anxious for position in water supply or sewerage work. Experience desired primarily; remuneration a secondary consideration. Good draftsman. Excellent references. Address "D. E.," % Water Works and Sewerage, 420 Lexington Ave., New York City.

SANITARY ENGINEER-CHEMIST — More than 20 years' experience in all phases water purification, sewage treatment and industrial wastes and stream pollution investigations. Experience in actual plant operation and special experience and accumulated data on industrial wastes and sewage treatment. For eleven years in charge of water supply, sewage and stream pollution work for one of the more active of State Health Departments. Permanent or temporary work desired. Address "G. C.," % Water Works and Sewerage, 420 Lexington Ave., New York City.

POSITIONS WANTED

This department has been started as a service to those in the Water Works and Sewerage Fields. We hope they will make use of it. The notices are inserted without charge.

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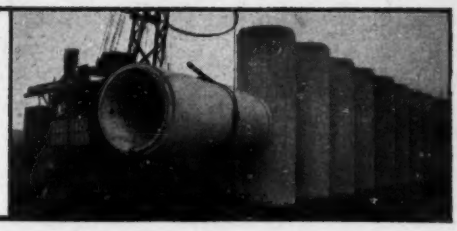

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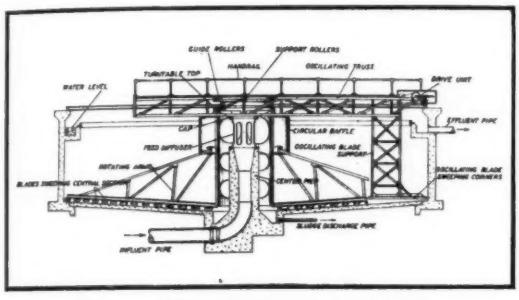

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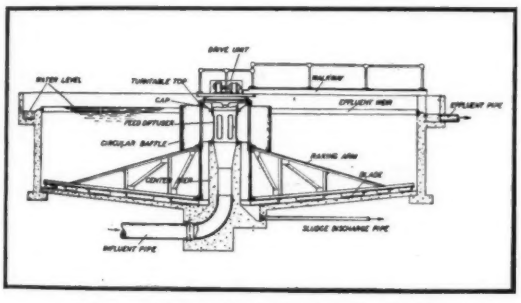

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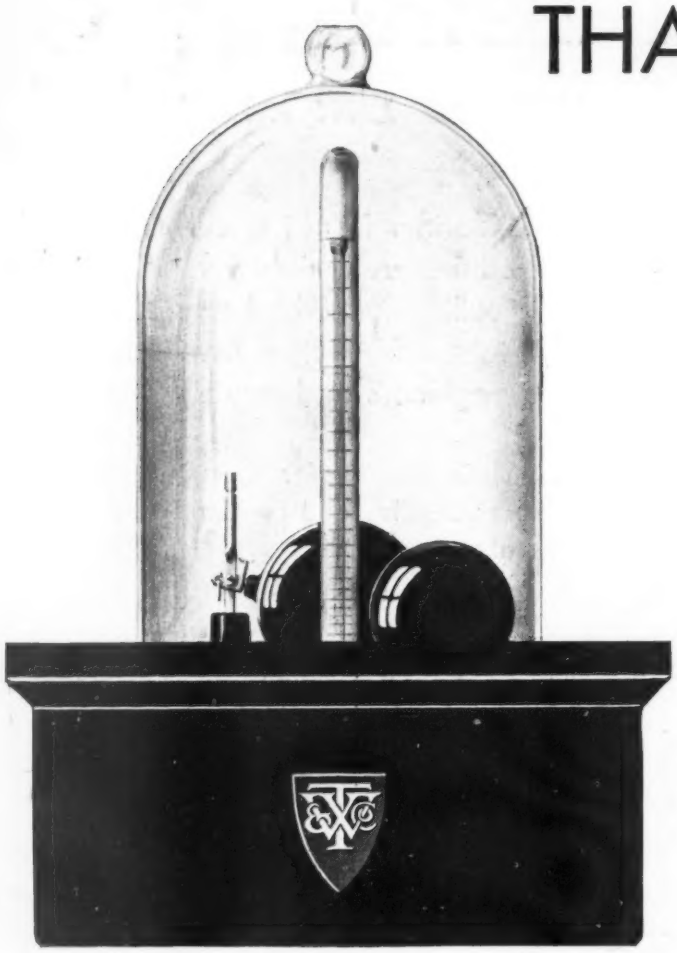

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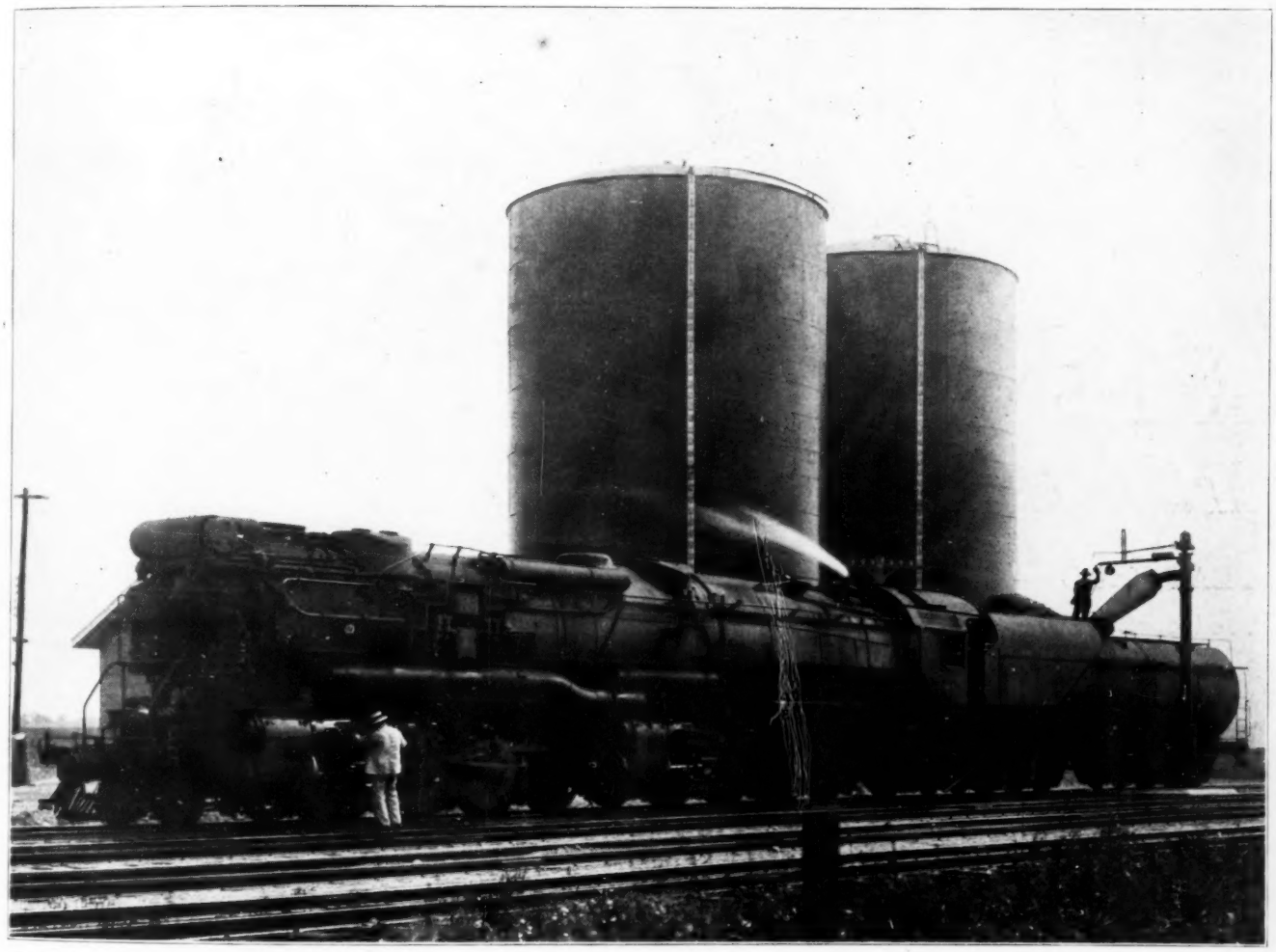

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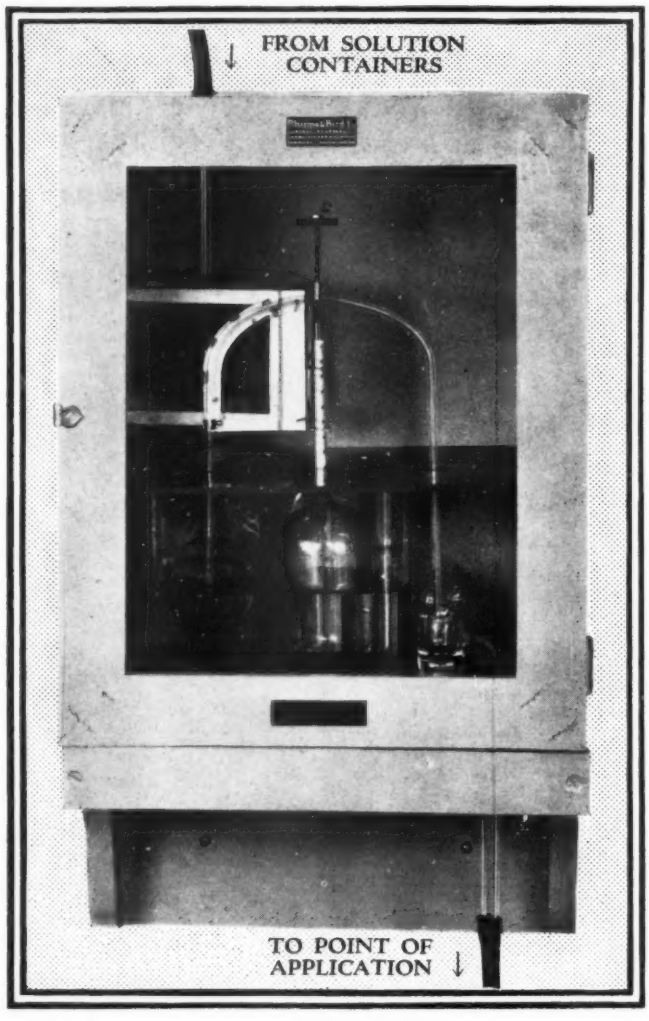

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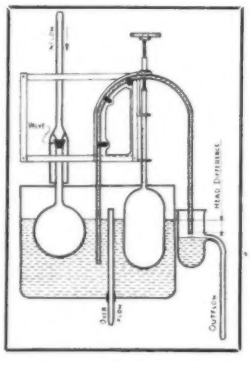

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